Nutritional Support in Patients with Chronic Respiratory Disease

Tai Joon An

Assistant Professor, The Catholic University of Korea

시작하기 전에

- Nutritional Support Team
- NST-PEP (professional education program)
- KSPEN/ESPEN/ASPEN 진료지침

Overview of Today’s Talk

- Nutrition - Malnutrition
- Carbohydrate, Lipid, and Protein
- Finding High Risk Patients and How to?

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- **Nutrition - Malnutrition**
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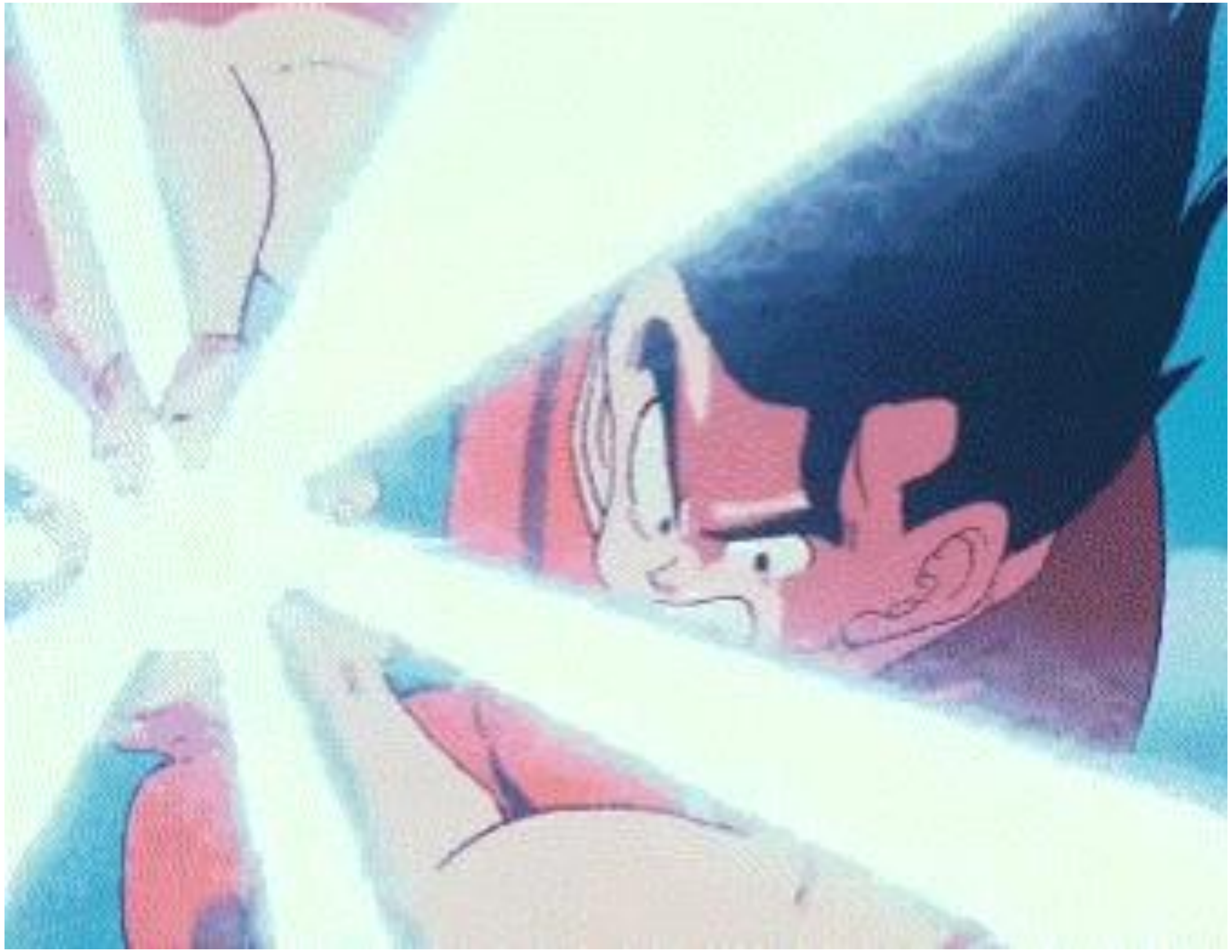
Energy – 초등학교 시절



Energy – 중고등학교 시절

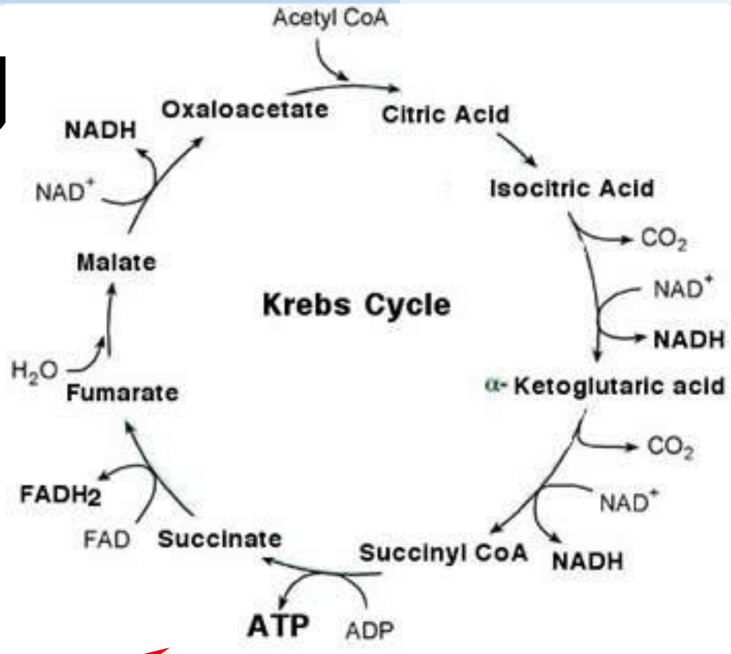
형태	설명	예시
운동 에너지 (Kinetic energy)	움직이는 물체가 가지는 에너지	달리는 자동차, 흐르는 물
위치 에너지 (Potential energy)	위치나 상태에 따라 잠재적으로 저장된 에너지	높은 곳에 있는 물체, 압축된 스프링
열 에너지 (Thermal energy)	온도에 따라 발생하는 에너지. 흔히 '열량'이라 표현됨	따뜻한 음식, 뜨거운 물
전기 에너지 (Electrical energy)	전자의 흐름에서 발생하는 에너지	콘센트, 전기 배터리
화학 에너지 (Chemical energy)	분자 결합 속에 저장된 에너지	음식, 연료, 배터리
핵 에너지 (Nuclear energy)	원자핵의 분열/융합에서 나오는 에너지	원자력 발전, 태양의 에너지
빛 에너지 (Radiant energy)	전자기파 형태로 전달되는 에너지	햇빛, 전등, X선
소리 에너지 (Sound energy)	공기 등 매질을 통한 파동으로 전달	음악, 말소리
파동 에너지 (Wave energy)	바다, 음파, 전자기파 등 파동에서 발생	해양 에너지, 라디오파

Energy in Biology – 대학교 시절

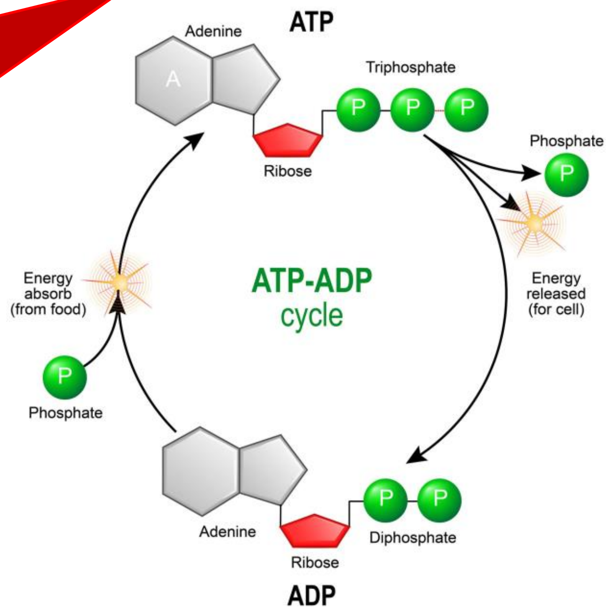
형태	설명	예시

Energy, Food, and Breathing

- **Food → Energy = Cellular Metabolism**
  - O_2 = Essential for aerobic metabolism
  - CO_2 = Byproduct of energy production
  - O2 소모 + CO_2 생성 → ATP 생성
  - **ATP = Core of Life = "Lungs are Life"**

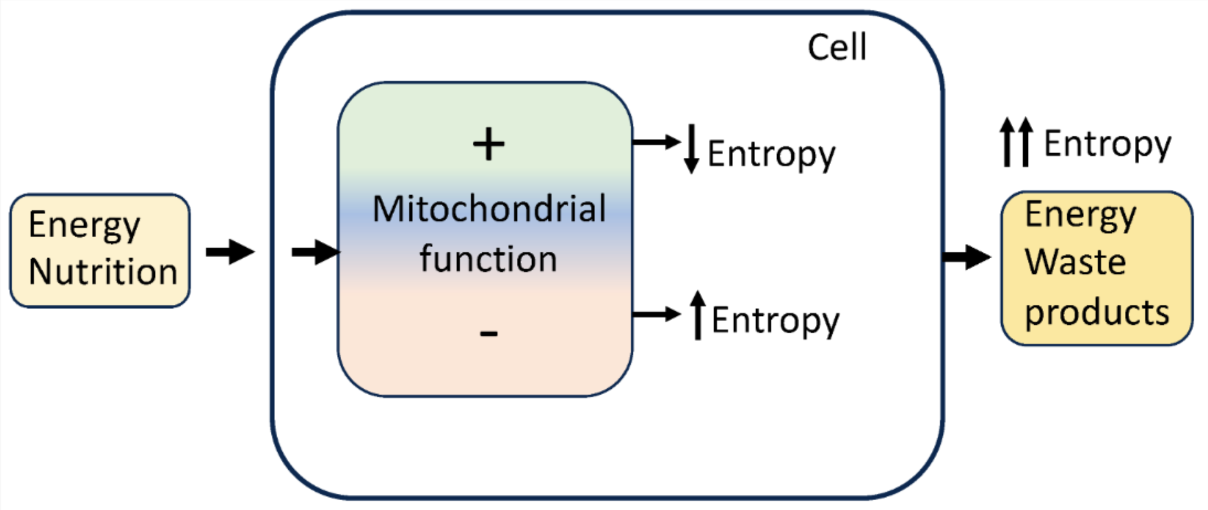


- **Chronic Respiratory Diseases**
  - Reduced O_2 + CO_2 retention
  - Acid-Base imbalance
  - Fatigue + Dyspnea → inefficient energy metabolism

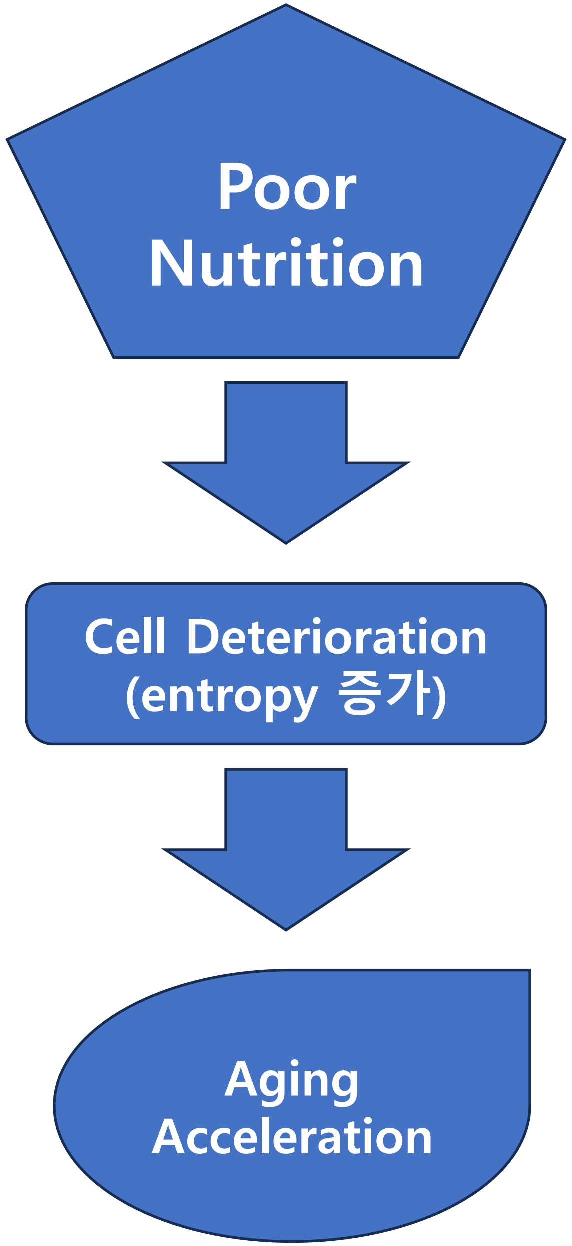


Energy? Entropy? Nutrition!

Figure 1. Organisms, cells, and mitochondria receive energy from an environment to reduce intracellular entropy by increasing mitochondrial function and energy conversion efficiency, improving repair and maintenance systems, and reducing ROS formation and cellular damage. These processes delay ageing. In contrast, decreased efficiency of energy conversion and decreased ability for cellular maintenance and repair lead to an increase in disorder and randomness (entropy), resulting in cell deterioration and accelerated ageing.



Int. J. Mol. Sci. **2024**, *25*(12), 6321



Nutrition = Energy Process

- **Nutrition = Digestion → Absorption → Metabolism (ATP)**

- **Essential Nutrients**
  - 1. Role
    - Energy Source: **Carbohydrates, Protein, Lipid**
    - Assistant: Minerals, Vitamins, Water
  - 2. Size
    - Macronutrient: **Carbohydrates, Protein, Lipid**, Water
    - Micronutrient: Vitamin, Minerals

Malnutrition

- **Mal-Nutrition**
  - Deficiency, Excess, or Imbalance in energy and/or nutrient intake
  - Under-nutrition
    - Stunting (low height of age)
    - Wasting (low weight for height)
    - Underweight (low weight for age)
    - Micronutrient deficiency
  - Over-nutrition
    - Overweight or Obesity

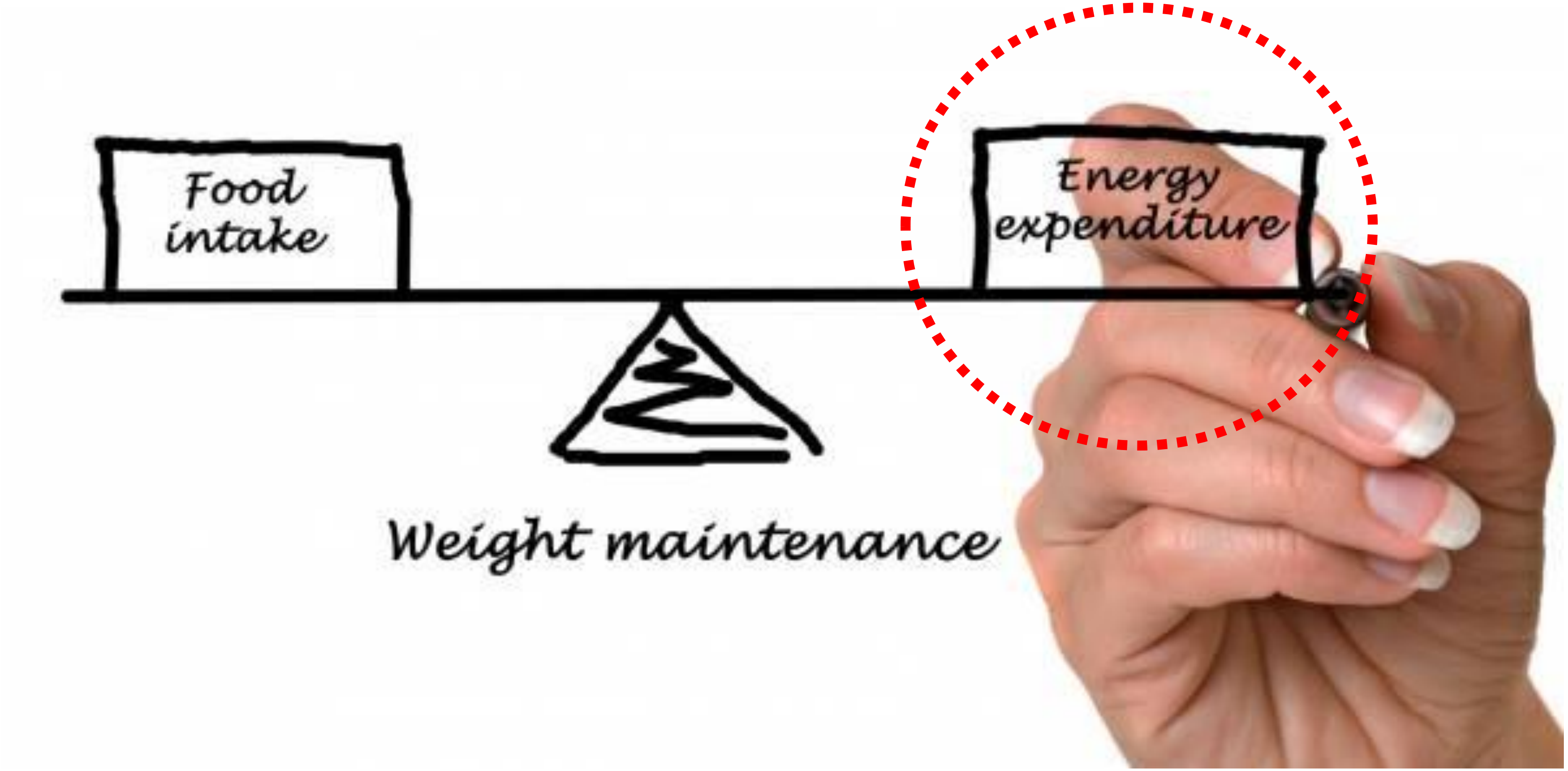
WHO

Why Mal-Nutrition Matters?

- Globally,
  - **890 million = Obesity**
  - **390 million = Underweight**
  - **149 million of children = Stunted**

- 2016-2025: UN Decade of Action on Nutrition

Balance between IN and OUT



TEE = Total Daily Energy Expenditure

High TEF
= 식사 후 체온 상승 → 에너지 소비 +
포만감 → 식욕 저하 + 저장 감소/소비 증가

High REE
= 기초 소모량의 증가
→ 저장 감소

Calculation

Name of equation	Equation
Harris–Benedict[23]	
Male	66.0+13.7 × weight (kg) + 5.0 × height (cm) – 6.8 × age (year)
Female	655.0+9.6 × weight (kg) + 1.7 × height (cm) – 4.7 × age (year)
Mifflin–St Jeor[24]	
Male	9.99 × weight (kg)+6.25 × height (cm) – 4.92 × age (year) + 5.00
Female	9.99 × weight (kg)+6.25 × height (cm) – 4.92 × age (year) – 161.00

연령상관계수 또는 상수가 음수
= 나이가 들수록 요구되는 열량의 감소

FAO/WHO/UNU[25]	
Male, age (years)	
18–30	15.4 × weight (kg) + 27.0 × height (m) + 717.0
31–60	11.3 × weight (kg) + 16.0 × height (m) + 901.0
≥61	8.8 × weight (kg) + 1,128.0 × height (m) + 1,071.0
Female, age (years)	
18–30	13.3 × weight (kg) + 334.0 × height (m) + 35.0
31–60	8.7 × weight (kg) + 25.0 × height (m) + 865.0
≥61	9.2 × weight (kg) + 637.0 × height (m) + 302.0

Schofield[26]	
Male, age (years)	
18–30	15.1 × weight (kg) + 692.0
31–60	11.5 × weight (kg) + 873.0
≥61	11.7 × weight (kg) + 588.0
Female, age (years)	
18–30	14.8 × weight (kg) + 487.0
31–60	8.1 × weight (kg) + 846.0
≥61	9.1 × weight (kg) + 659.0

WHO

Age and Calories

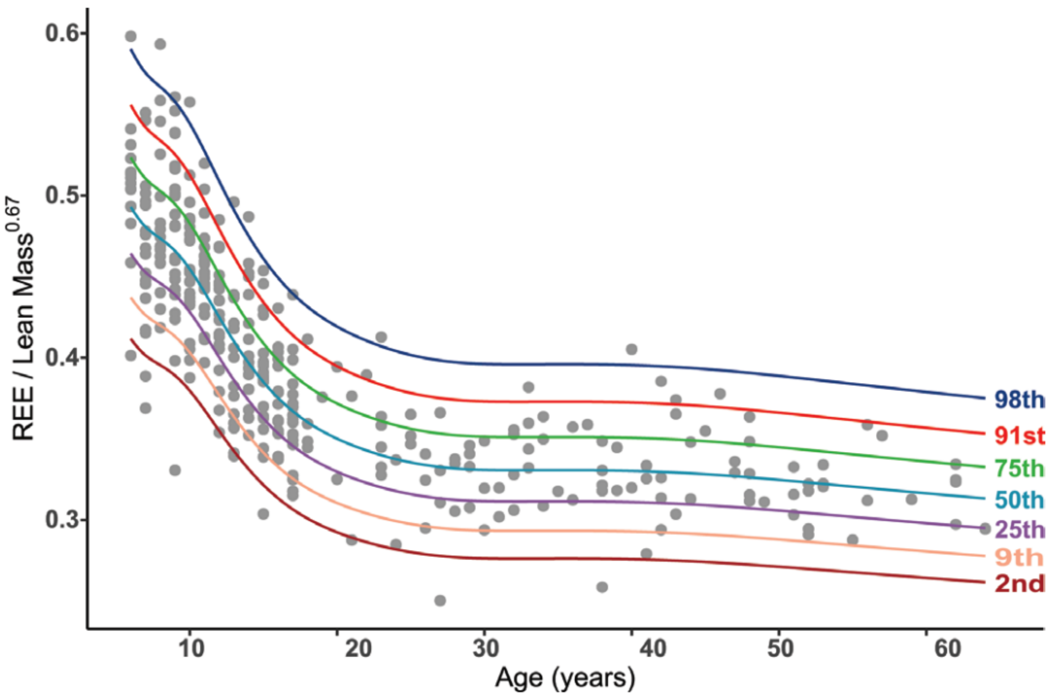
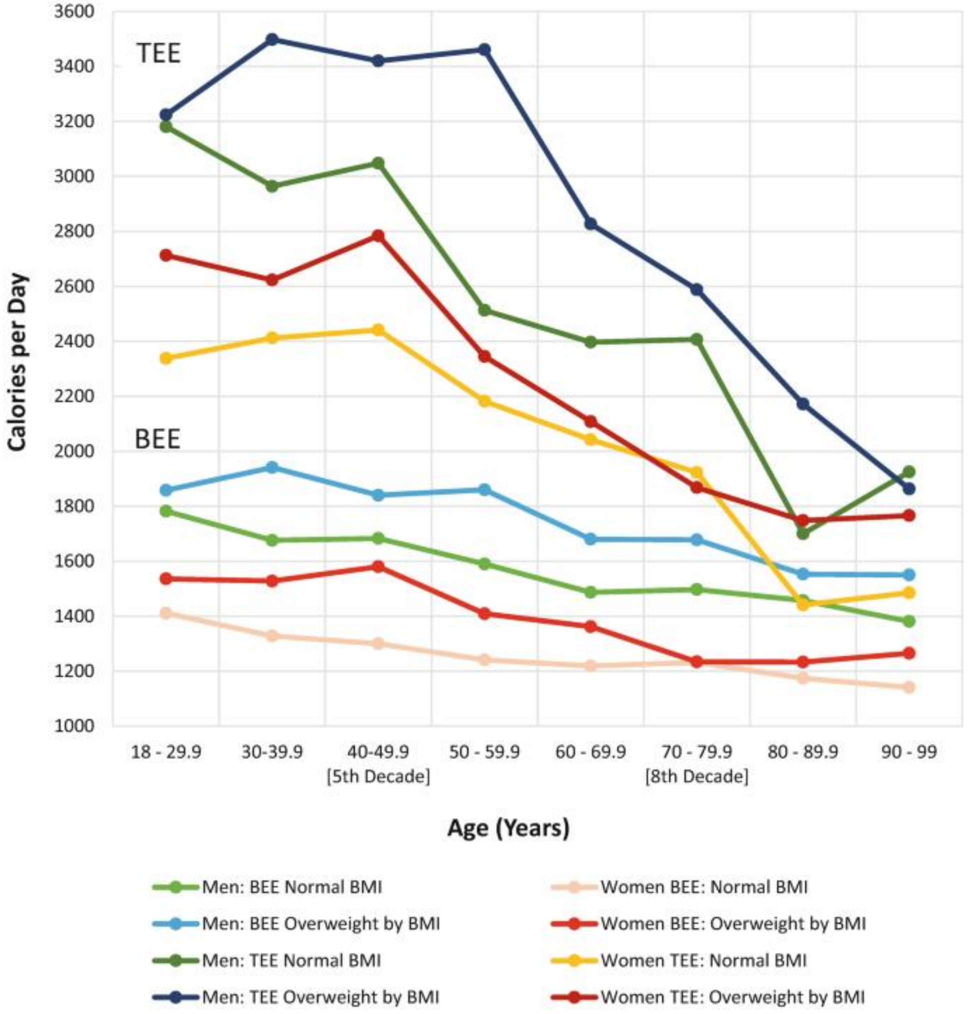
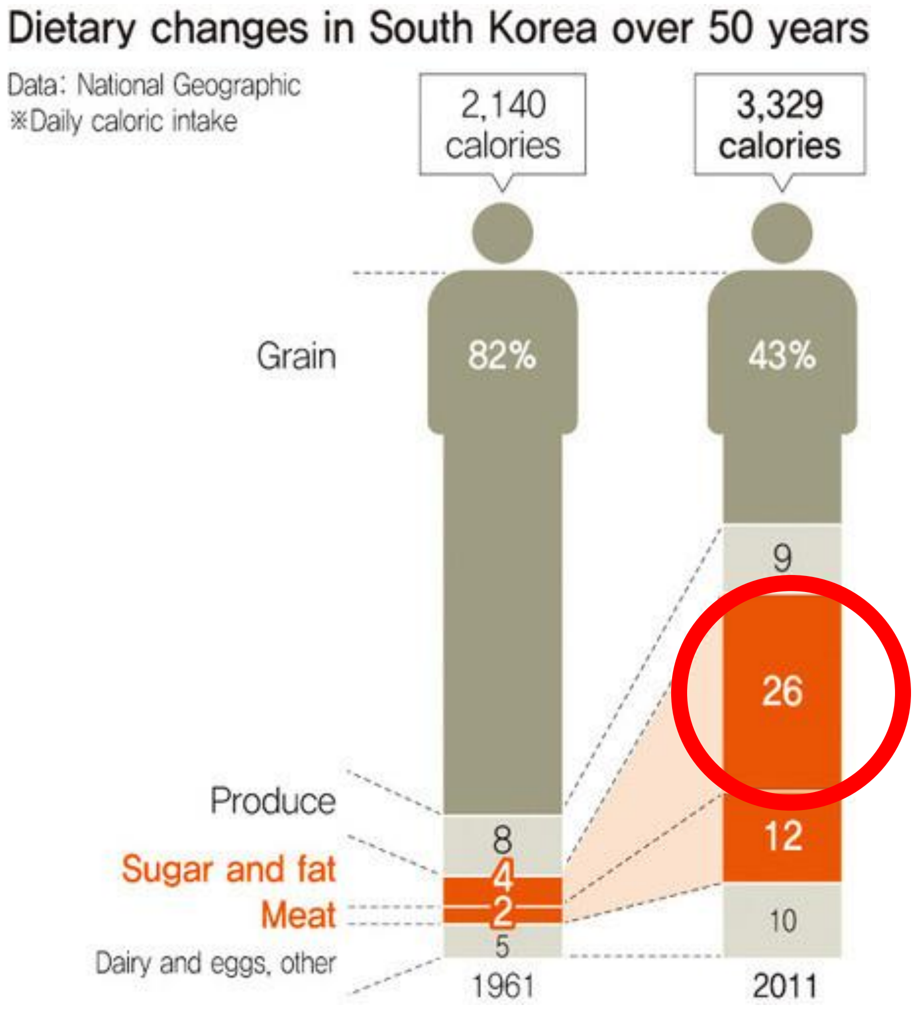


Figure 1 Resting energy expenditure (REE) index centile curves for the 2nd through to the 98th centile plotted against age.



Watson L, et al. Arch Dis Child 2023;108:545–549.
Geriatric Medicine. Springer, Cham.
https://doi.org/10.1007/978-3-030-01782-8_110-1

Trends of Korean Nutrition Status



	30-49	50-64	≥ 65
실 에너지 섭취량	1942.2	1829.31	1596.76
(권장 섭취량: 남/여)	2300/1900	2100/1700	1900/1400
탄수화물 섭취량(g)	256.29	265.28	254.16
단백질 섭취량(g)	74.46	68.44	58.84
지방 섭취량(g)	58.19	46.54	35.02

건강 성인

국민건강영양조사 2013-2017

Weight Loss

Nutritional Disadvantage in COPD

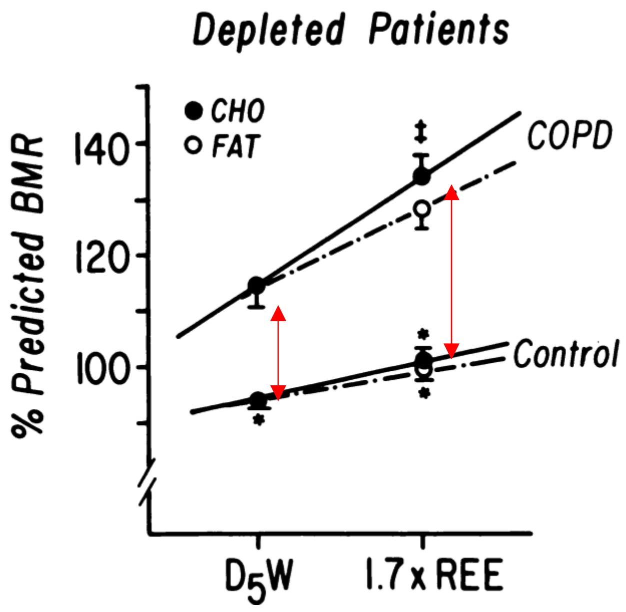
Energy Expenditure in Patients with Chronic Obstructive Pulmonary Disease*

S. Goldstein, M.S.; J. Askanazi, M.D., F.C.C.P.; C. Weissman, M.D.; B. Thomashow, M.D., and J. M. Kinney, M.D.

Table 1—*Patient Characteristics at the Time of Admission to Study*

	COPD patients (n=10)	Malnourished patients (n=5)
Age (yrs)	71±2	69±4
Weight (kg)	45±2.1	49±7
% weight loss	14±1	15±3
FVC (% predicted)	58±4	70±6*
FEV_1 (% predicted)	29±3	76±9*
PaO_2 (mmHg)	68±4	89±4*
REE (% predicted BMR)	116±3	90±1

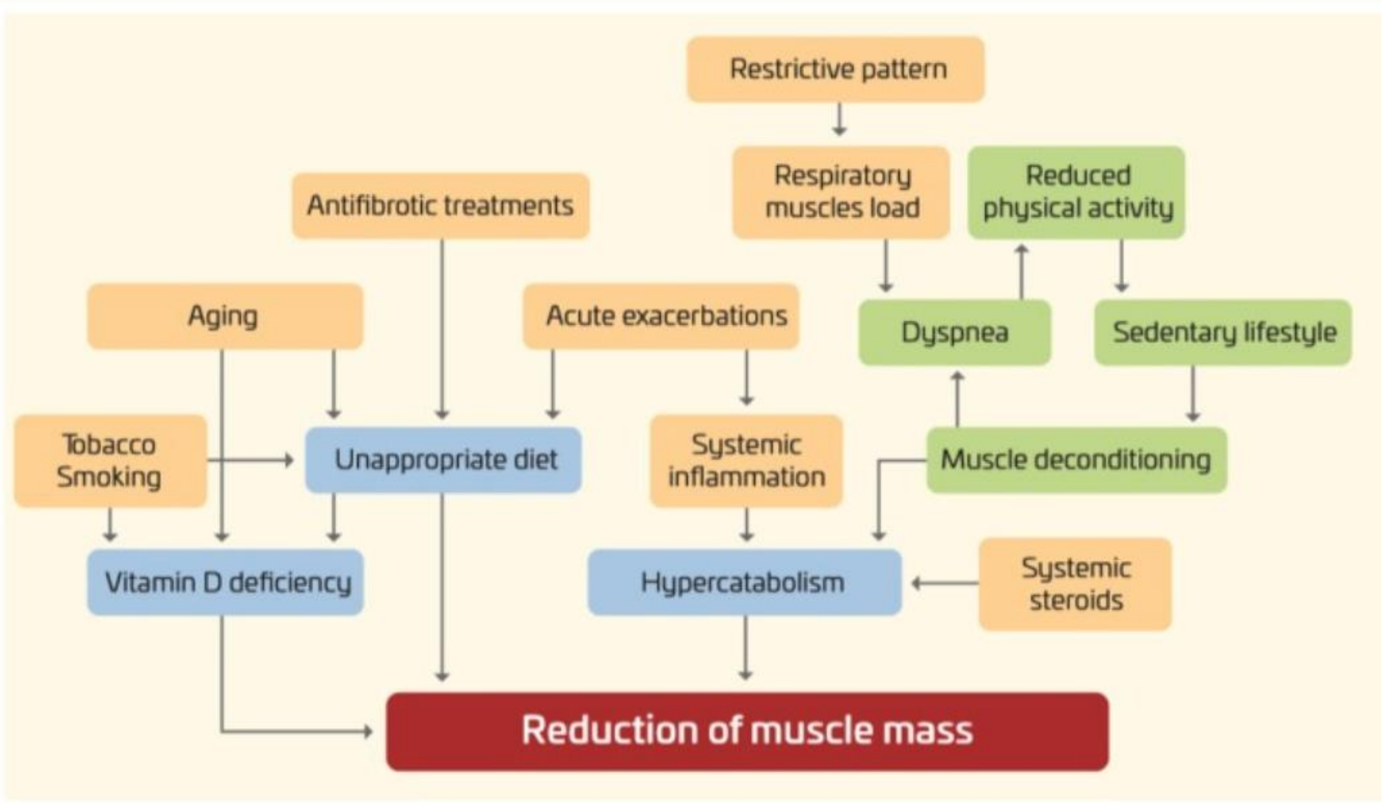
*p<0.001 compared to patients with COPD



Increased REE + increased food thermogenesis → Weight-loss + Decreased caloric intake

Chest 1987 Feb;91(2):222-4

Nutritional Disadvantage in IPF



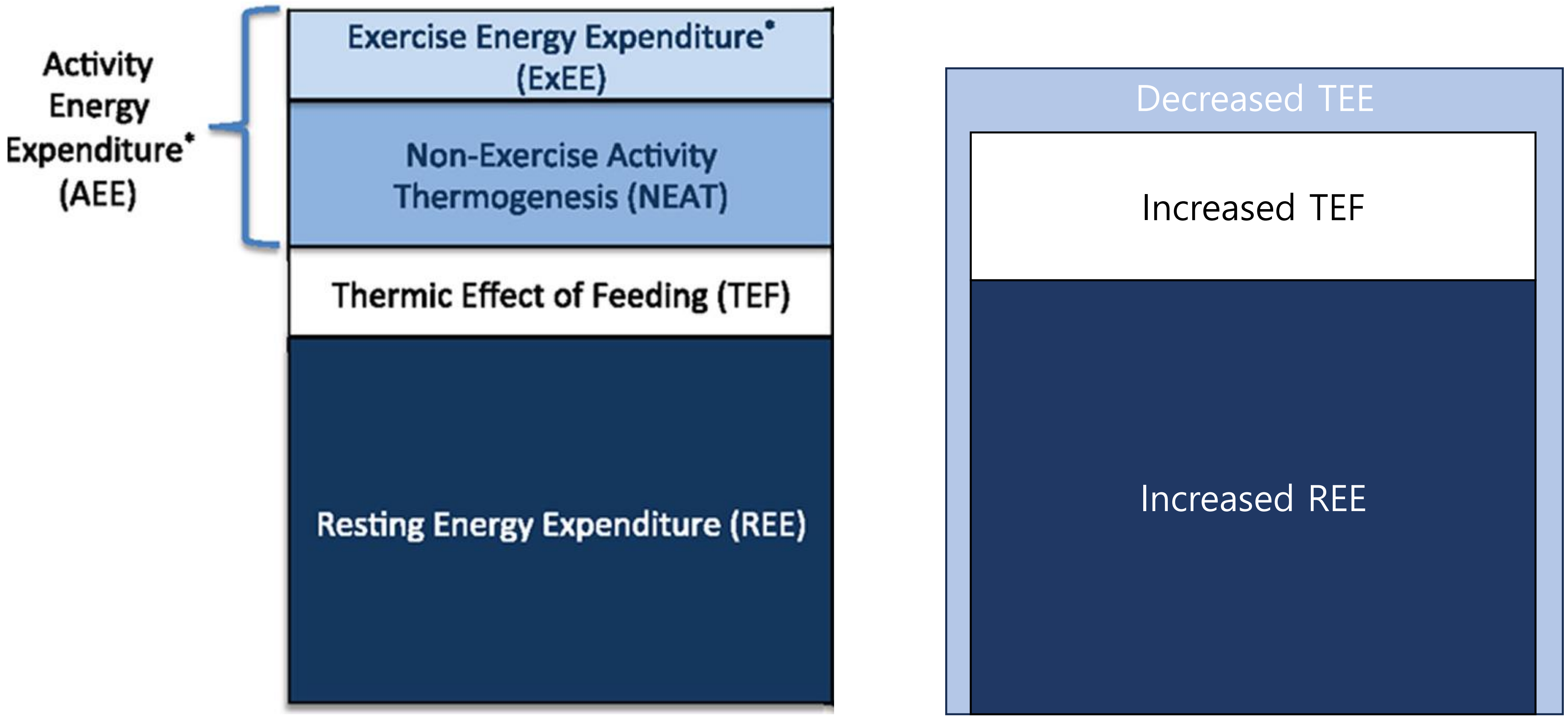
In IPF patients,

Similar risk (vs. COPD)

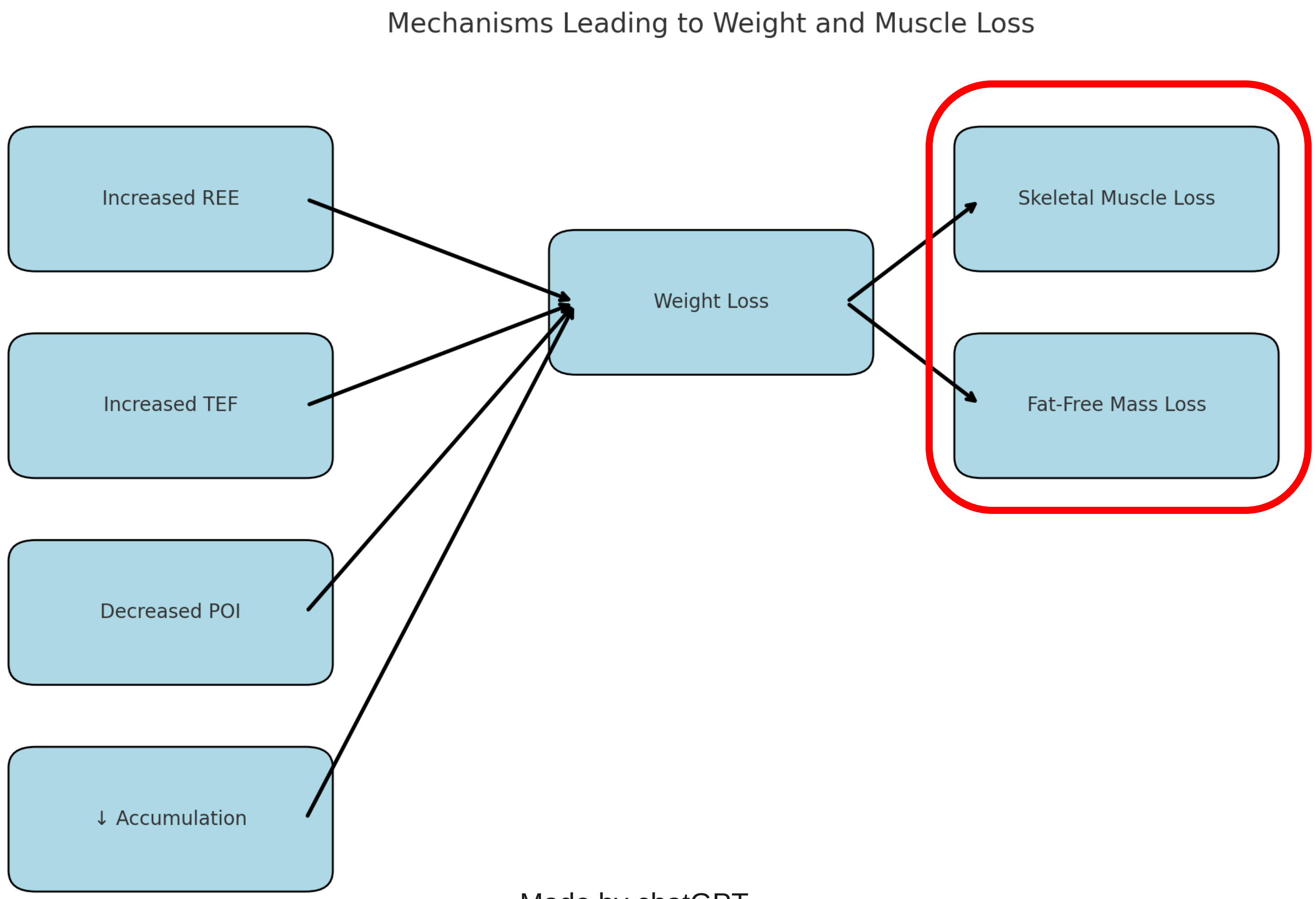
+ Drug effect
(vomiting, diarrhea)

Nutrients. 2020 Apr 17;12(4):1131

Weight Loss Mechanism in Chronic Respiratory Disease



Weight Loss
- To shrink, or not to shrink, that is the question



Made by chatGPT

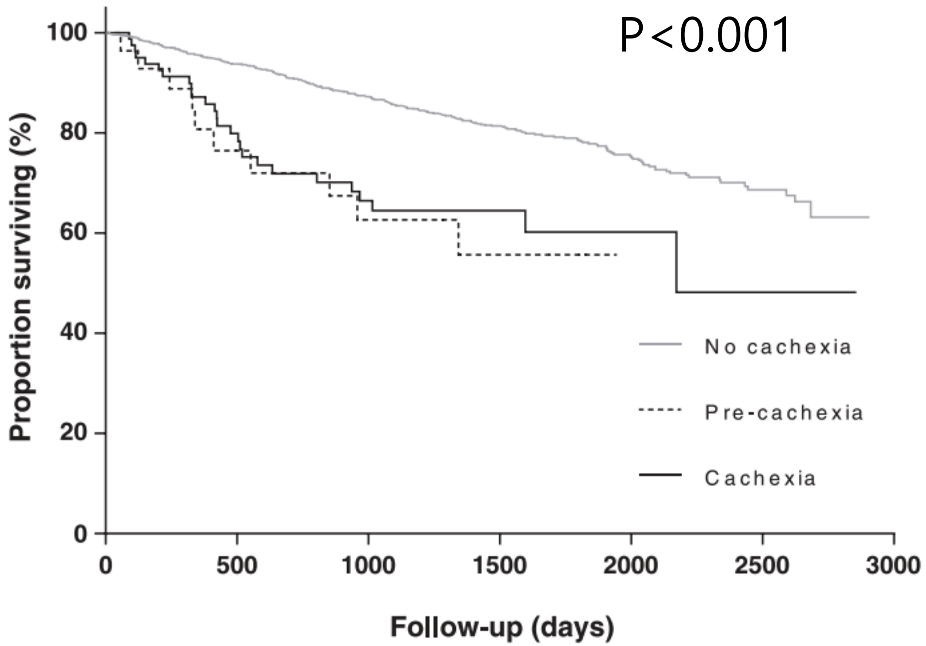
Weight Loss
- To shrink, or not to shrink, that is the question

The prognostic significance of weight loss in chronic obstructive pulmonary disease-related cachexia: a prospective cohort study

Hoi Yee Kwan[1,2†], Matthew Maddocks[3*], Claire M. Nolan[2,4], Sarah E. Jones[2,4], Suhani Patel[2], Ruth E. Barker[2], Samantha S.C. Kon[2,5], Michael I. Polkey[4], Paul Cullinan[4] & William D.-C. Man[2,4]

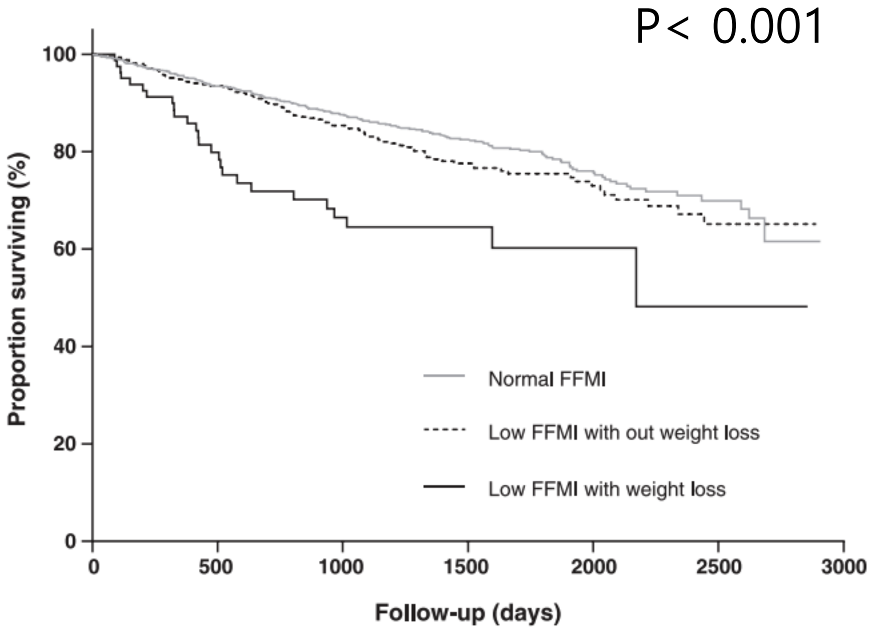
Journal of Cachexia, Sarcopenia and Muscle 2019; 10: 1330–1338

Weight Loss
- To shrink, or not to shrink, that is the question



Number at risk

Cachexia	81	51	34	16	6	1	0
Precachexia	28	17	13	6	0	0	0
Without cachexia	1646	1305	892	564	269	82	0



Number at risk

Normal FFMI	1054	850	631	403	186	54	0
Low FFMI without weight loss	620	472	274	167	83	28	0
Low FFMI with weight loss	81	51	34	16	6	1	0

Journal of Cachexia, Sarcopenia and Muscle 2019; 10: 1330–1338

Weight Loss
- To shrink, or not to shrink, that is the question

Prognostic value of weight change in chronic obstructive pulmonary disease: results from the Copenhagen City Heart Study

E. Prescott*,#, T. Almdal¶, K.L. Mikkelsen+, C.L. Tofteng*,#, J. Vestbo§, P. Lange*,§

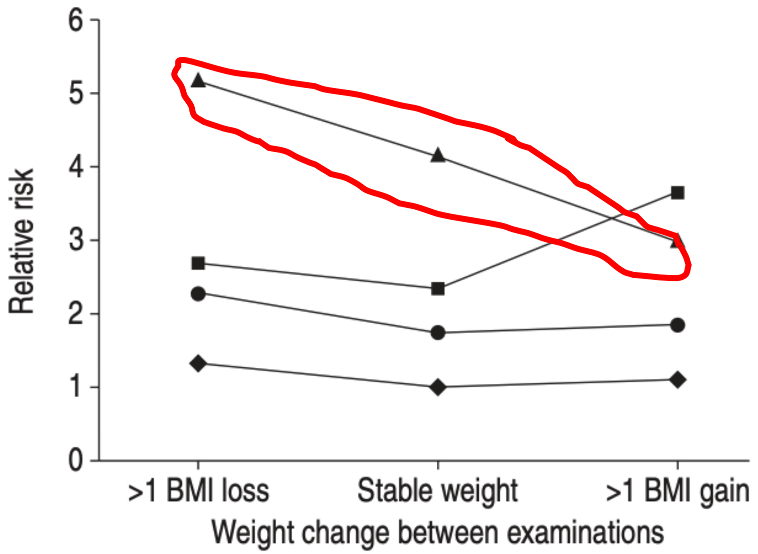


Fig. 1.–All-cause mortality by weight change in subjects with no/mild chronic obstructive pulmonary disease (COPD), moderate COPD and severe COPD. Subjects with no/mild COPD with stable weight were used for reference. ▲: severe COPD body mass index (BMI) <25; ■: severe COPD BMI >25; ●: moderate COPD; ◆: no/mild COPD.

	COPD $FEV_1/FVC<0.7$
Weight change in BMI units#	
>-3 kg·m^{-2}	2.14 (1.18–3.89)
-1–3 kg·m^{-2}	1.31 (0.89–1.92)
-1–+1 kg·m^{-2}	ref
+1–3 kg·m^{-2}	0.83 (0.53–1.32)
>+3 kg·m^{-2}	0.95 (0.43–2.08)
Test for linear trend	p=0.01
Initial BMI	
<20 kg·m^{-2}	1.68 (1.06–2.66)
20–24.9 kg·m^{-2}	ref
25–29.9 kg·m^{-2}	0.66 (0.44–0.98)
>=30 kg·m^{-2}	0.72 (0.38–1.35)
Test for linear trend	p=0.002
FEV_1 % pred (per 10% decrease)	1.50 (1.37–1.65)

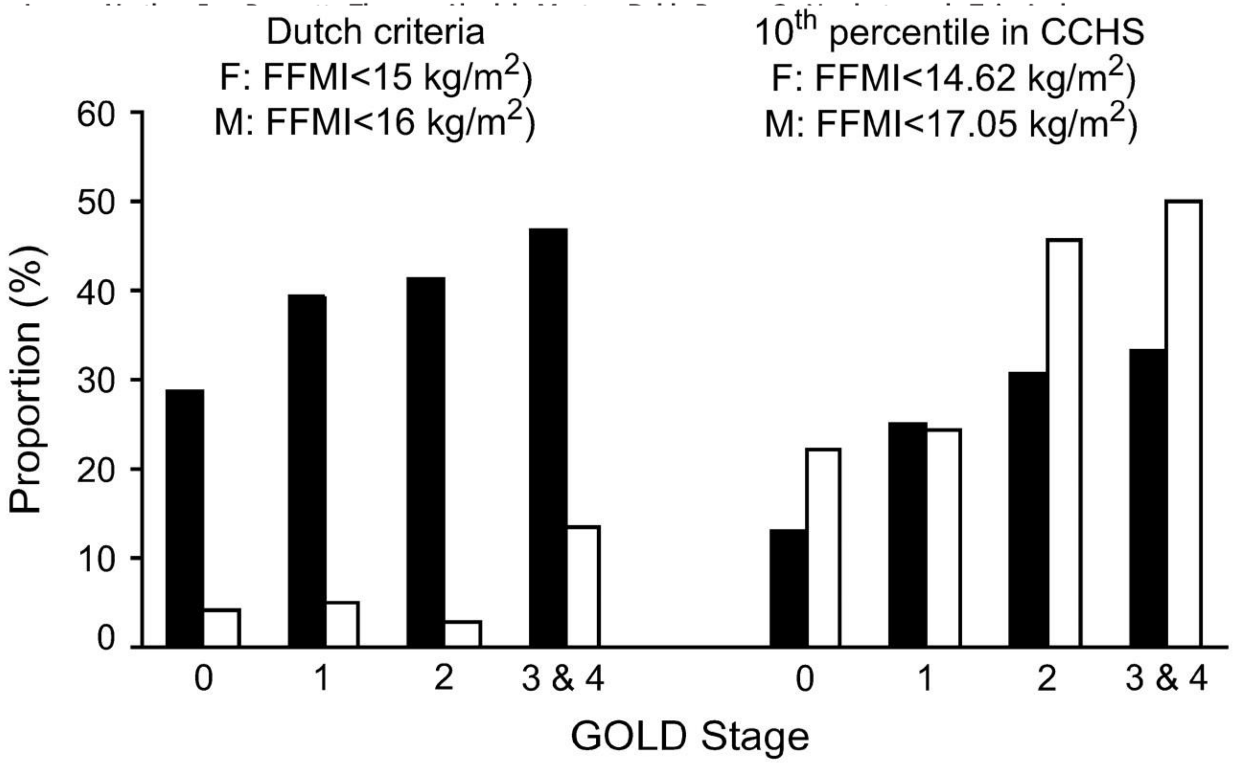
Data are presented as RR (95% confidence interval). FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; ref: reference group. #: One unit body mass index (BMI) is equivalent of height in metres squared, *i.e.*, in a subject 170 centimetres high one unit change in BMI is equal to 3.89 kg.

Eur Respir J 2002; 20: 539–544

Weight Loss
- To shrink, or not to shrink, that is the question

Body Mass, Fat-Free Body Mass, and Prognosis in Patients with Chronic Obstructive Pulmonary Disease from a Random Population Sample

Findings from the Copenhagen City Heart Study



	Low FFMI†
All subjects with COPD	
Overall mortality	1.5 (1.2–1.8)
COPD mortality	2.4 (1.4–4.1)
Subjects with normal BMI*	
Overall mortality	1.3 (1.1–1.7)
COPD mortality	2.0 (0.9–4.5)

Am J Respir Crit Care Med Vol 173. pp 79–83, 2006

Weight Loss
- To shrink, or not to shrink, that is the question

A 1-year follow-up study in patients with idiopathic pulmonary fibrosis regarding adverse outcomes to unintended weight loss

Mette Holst Ph.D. [a,b,*], Christina Nielsen M.Sc. [c], Lotte Flink Sørensen M.Sc. [c], Benedicte Torp Ladefoged M.Sc. [c], Sofie Meyer Andersen M.Sc. [c], Samantha Drejer Thomsen M.Sc. [c], Sabina Lund Mikkelsen M.Sc. [a]

[a] *Center for Nutrition and Intestinal Failure, Department of Gastroenterology, Aalborg University Hospital, Aalborg, Denmark*
[b] *Department of Clinical Medicine, Aalborg University, Aalborg, Denmark*
[c] *Department of Health Science and Technology, Aalborg University, Aalborg, Denmark*

Nutrition 108 (2023)

Weight Loss
- To shrink, or not to shrink, that is the question

Table 3
The association between unintended weight loss at baseline and follow-up regarding mortality, hospital admission, and risk of sarcopenia

Variable	Unintended weight loss at baseline			
	OR (95% CI) (unadjusted)	*P* value	OR (95% CI) (adjusted)	*P* value
Dead (yes)	9.67 (0.56–168.04)	0.119	29.81 (1.22–728.00)	0.037*
Admission (yes)	6.99 (1.40 – 34.99)	0.018*	14.68 (1.94–110.68)	0.009*
	Unintended weight loss at follow-up			
	OR (95% CI) (unadjusted)	*P* value	OR (95% CI) (adjusted)	*P* value
Sarcopenia, SARC-F (≥ 4) (yes)	5.08 (1.41–18.23)	0.013*	4.00 (0.99–16.16)	0.052
Admissions (yes)	2.41 (0.70–8.30)	0.162	3.26 (0.61–17.44)	0.168
Unintended weight loss at baseline (yes)	0.94 (0.11–8.35)	0.952	0.43 (0.03–5.50)	0.515

CI, confidence interval; OR, odds ratio; SARC-F, strength, assistance with walking, rising from a chair, climbing stairs, and falls questionnaire.
$^*P < 0.05$.

Nutrition 108 (2023)

Weight Gain

Weight Gain
- To obese, or not to obese, that is the question

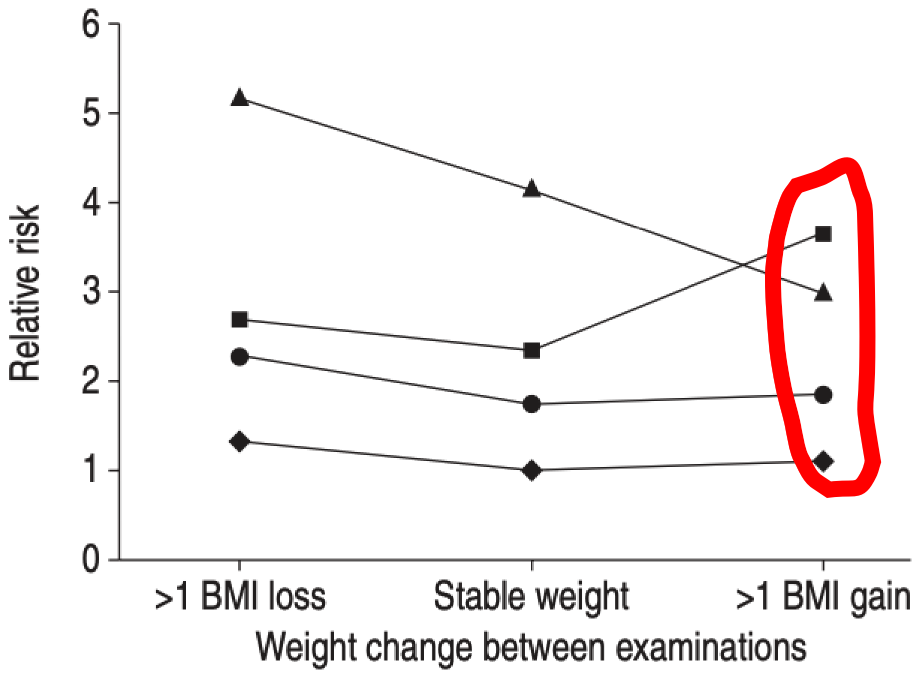
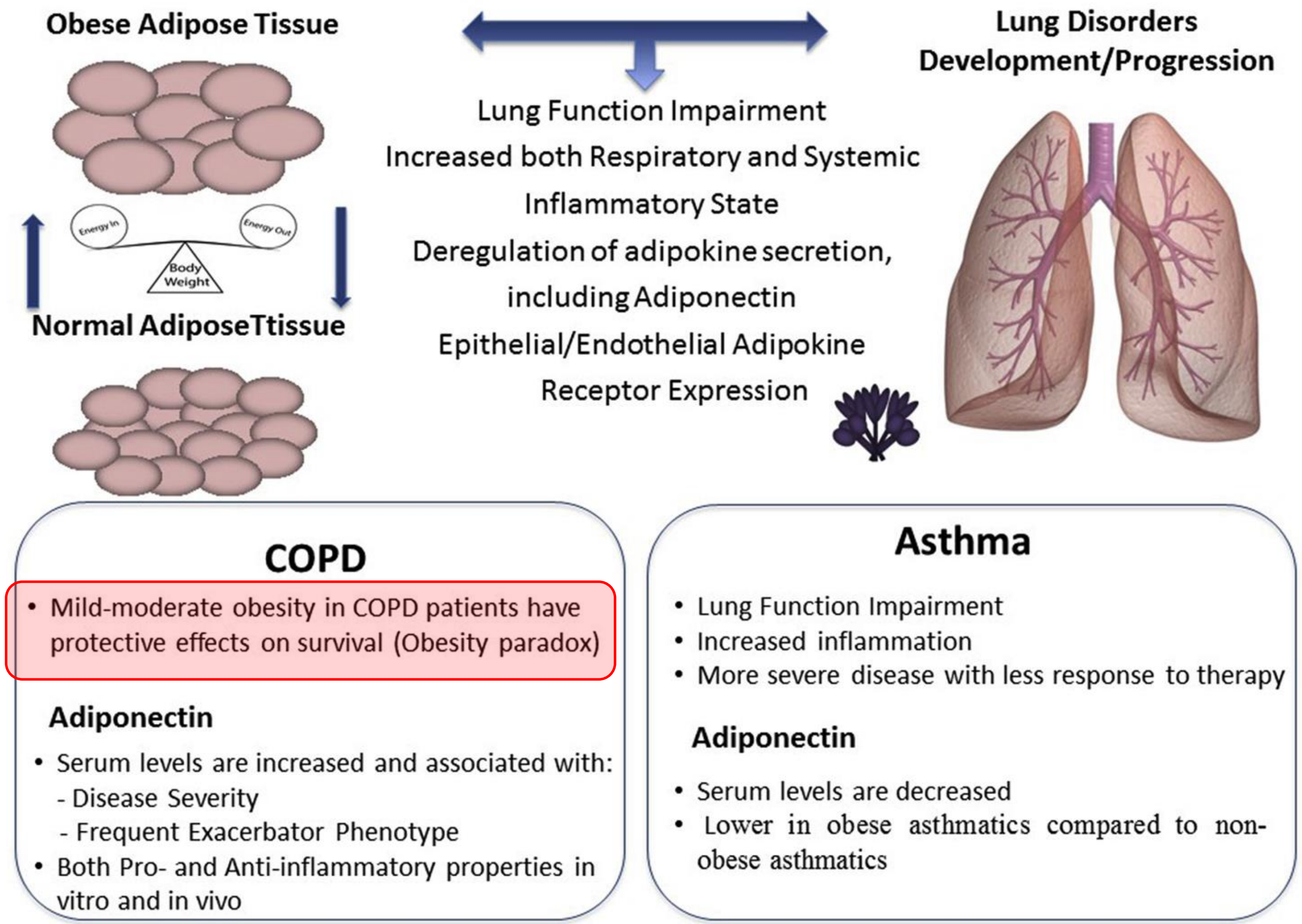


Fig. 1. – All-cause mortality by weight change in subjects with no/mild chronic obstructive pulmonary disease (COPD), moderate COPD and severe COPD. Subjects with no/mild COPD with stable weight were used for reference. ▲: severe COPD body mass index (BMI) <25; ■: severe COPD BMI >25; ●: moderate COPD; ◆: no/mild COPD.

Eur Respir J 2002; 20: 539–544

Weight Gain
- To obese, or not to obese, that is the question



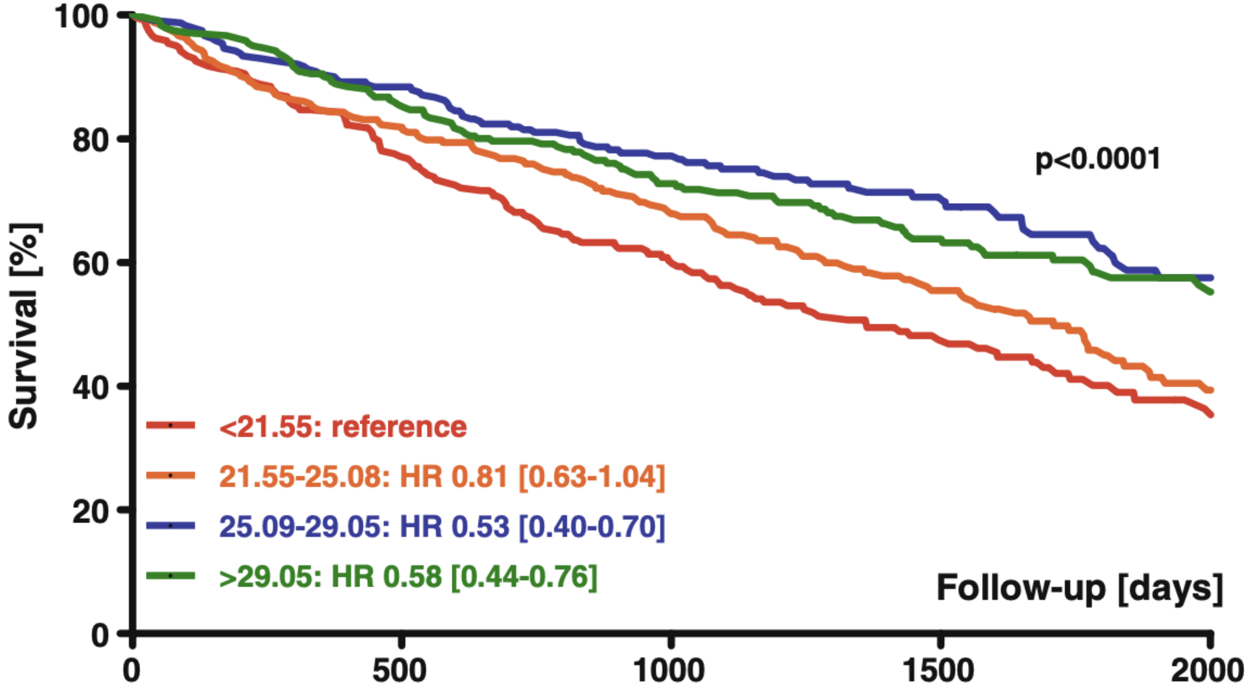
Pulm Pharmacol Ther 2017 Apr:43:20-25

Weight Gain
- To obese, or not to obese, that is the question

Body mass index and prognosis in patients hospitalized with acute exacerbation of chronic obstructive pulmonary disease

Mitja Lainscak · Stephan von Haehling · Wolfram Doehner · Irena Sarc · Tina Jeric · Kristina Ziherl · Mitja Kosnik · Stefan D. Anker · Stanislav Suskovic

- Obesity paradox
  - Mod: protective
  - Sev: poor prognosis



Number at risk BMI					
<21.55	242	184	123	72	27
21.55-25.08	242	199	146	95	37
25.09-29.05	242	210	153	92	41
>29.05	242	206	152	101	49

J Cachexia Sarcopenia Muscle (2011) 2:81–86

Weight Gain
- To obese, or not to obese, that is the question

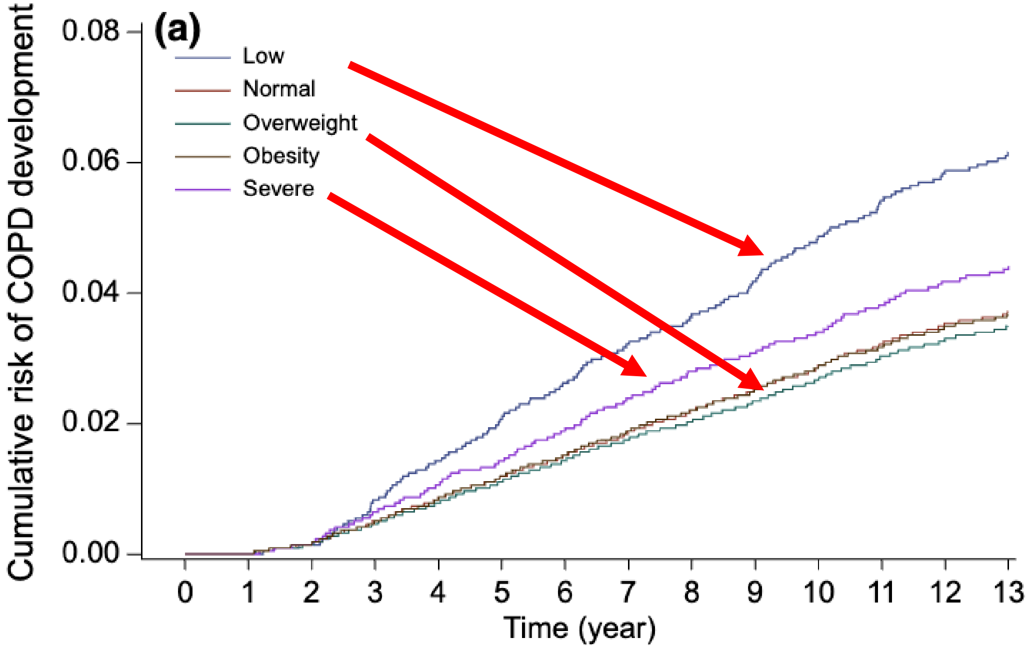
JIM Original Article

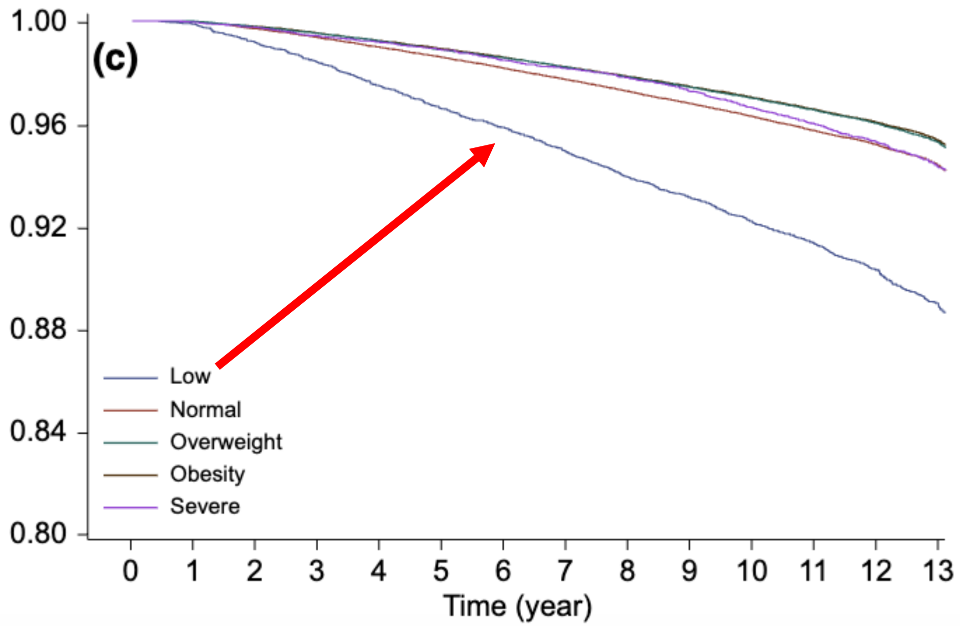
doi: 10.1111/joim.12949

The effect of low body mass index on the development of chronic obstructive pulmonary disease and mortality

H. J. Park[1], J. H. Cho[1], H. J. Kim[1], J.-Y. Park[2], H. S. Lee[2] & M. K. Byun[1]

From the [1]Department of Internal Medicine, Gangnam Severance Hospital,Yonsei University College of Medicine, Seoul, Korea ; and [2]Biostatistics Collaboration Unit, Yonsei University College of Medicine, Seoul, Korea





J Intern Med 2019; 286: 573–582

Different Comorbidities

Chronic Obstructive Pulmonary Diseases:
Journal of the COPD Foundation

COPD FOUNDATION

Original Research

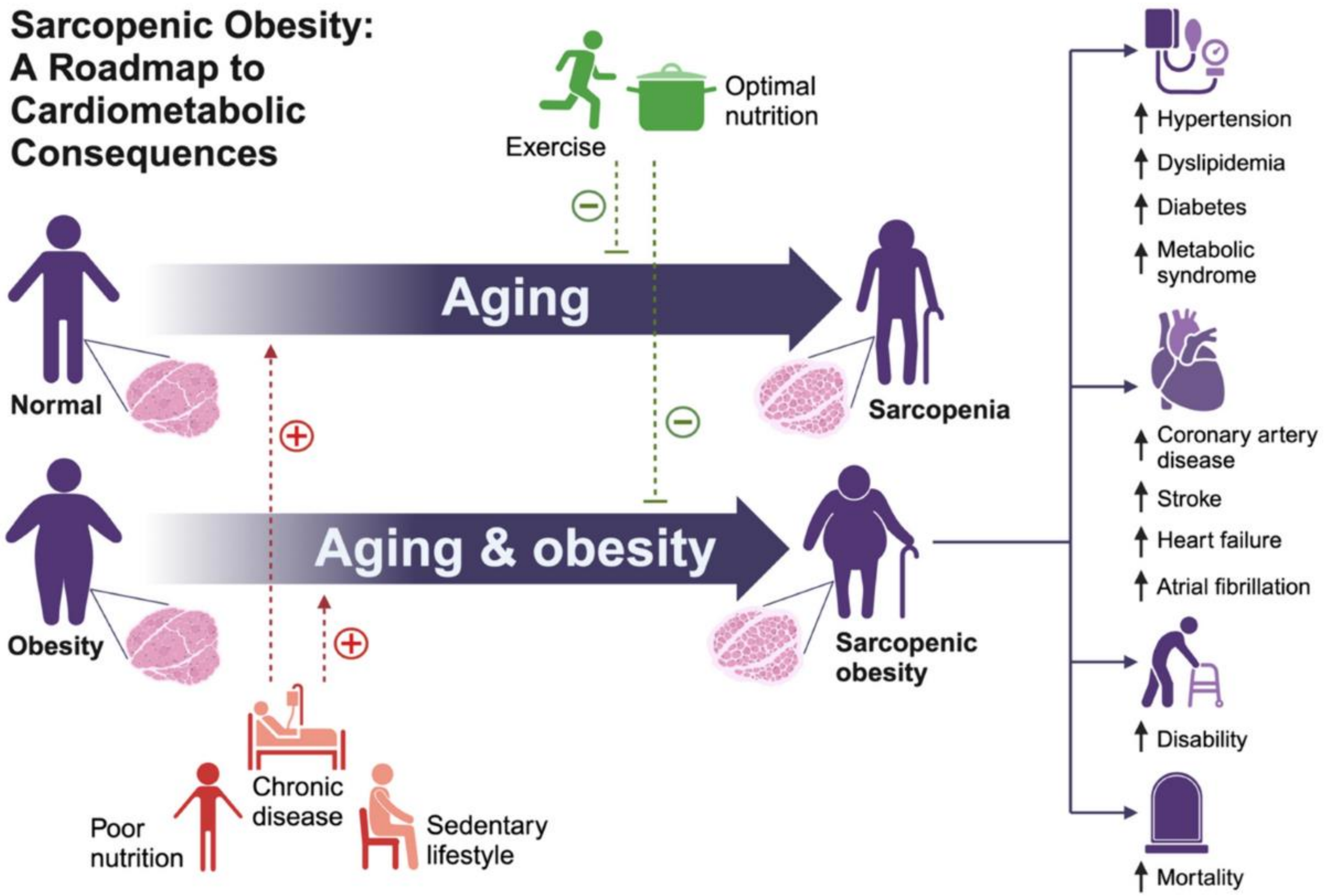
Comorbidity Distribution, Clinical Expression and Survival in COPD Patients with Different Body Mass Index

Miguel J. Divo, MD,[1] Carlos Cabrera, MD,[2] Ciro Casanova, MD,[3] Jose M. Marin, MD,[4] Victor M. Pinto-Plata, MD,[1] Juan P. de-Torres, MD,[5] Javier Zulueta, MD,[5] Jorge Zagaceta, MD,[5] Pablo Sanchez -Salcedo, MD,[5] Juan Berto, MD,[5] Claudia Cote, MD,[6] and Bartolome R. Celli, MD[1] for the BODE Collaborative Group

J COPD F. 2014; 1(2): 229-238.

Comorbidity	Prevalence (%)	Hazard Ratio	95% CI	p
BMI≤21 kg/m²				
Atrial Fibrillation/Flutter	14	1.63	0.99 - 2.58	0.0504
Coronary Artery Disease	28	1.71	1.12 - 2.60	0.0134
21<BMI<25 kg/m²				
Hypertension	46	1.62	1.04 - 2.51	0.0315
Diabetes with Neuropathy	2	4.37	1.102 - 13.35	0.0374
25≤BMI<30 kg/m²				
Coronary Artery Disease	29	1.38	1.01 - 1.88	0.047
Atrial Fibrillation/Flutter	12	1.52	1.04 - 2.20	0.0324
Pulmonary Hypertension	9	1.61	1.08 - 2.35	0.0204
Pulmonary Fibrosis	8	1.86	1.19 - 2.82	0.0079
Congestive Heart Failure	14	1.94	1.32 - 2.80	0.0009
Lung Cancer	10	2.12	1.45 - 3.02	0.0002
Liver Cirrhosis	2	2.96	1.39 - 5.68	0.0068
BMI≥30 kg/m²				
Diabetes Mellitus	36	1.52	1.01 - 2.28	0.0429
Pulmonary Hypertension	11	1.82	1.10 - 2.93	0.0198
Pulmonary Fibrosis	5	1.98	1.02 - 3.57	0.0427
Lung Cancer	8	4.16	2.65 - 6.39	<.0001

Sarcopenic Obesity



Curr Obes Rep **13**, 532–544 (2024)

Sarcopenic Obesity

Wang et al. BMC Pulmonary Medicine (2023) 23:394
https://doi.org/10.1186/s12890-023-02702-2

BMC Pulmonary Medicine

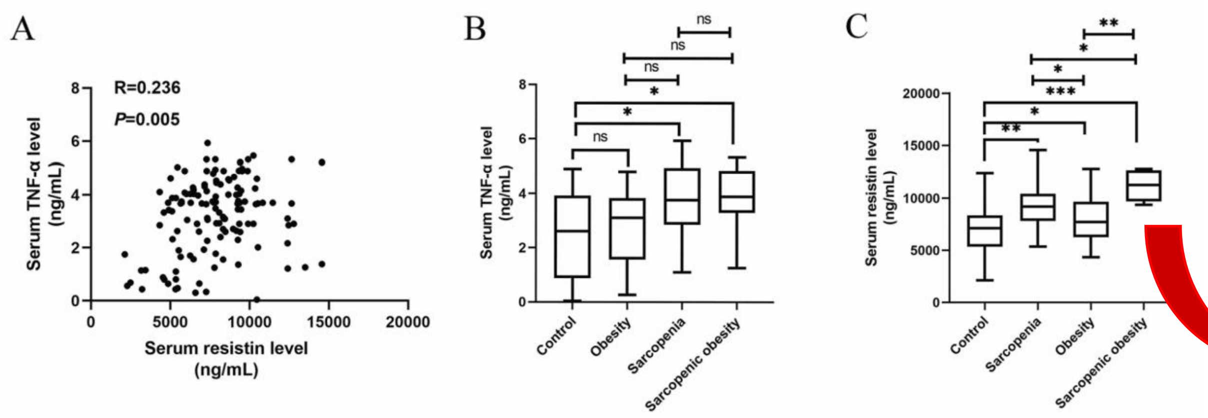
RESEARCH | Open Access

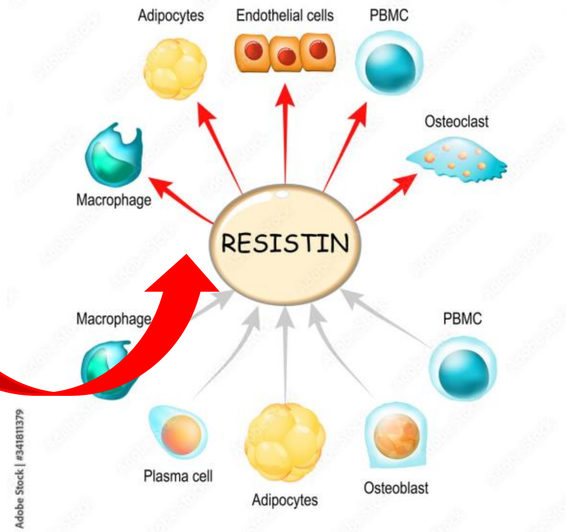
Clinical impacts of sarcopenic obesity on chronic obstructive pulmonary disease: a cross-sectional study

Zilin Wang[1,2†], Xiaoming Zhou[5†], Mingming Deng[1], Yan Yin[3], Yanxia Li[4], Qin Zhang[1], Yiding Bian[1,2], Jinrui Miao[1], Jiaye Li[1] and Gang Hou[1*]

Table 2 Respiratory Symptoms and Health-Related Quality of Life Associated with Sarcopenic Obesity in Patients with COPD

Variable	NBC (n = 66)	Obesity (n = 59)	Sarcopenia (n = 54)	Sarcopenic Obesity (n = 19)	*P*-value
mMRC score	0.84 ± 0.99	1.59 ± 1.26*	1.90 ± 1.24*	3.09 ± 1.04$^{*,\#,\&}$	< 0.001
CAT scores	10.69 ± 6.73	12.81 ± 7.18	16.26 ± 9.53*	23.30 ± 8.37$^{*,\#,\&}$	< 0.001
SGRQ					
SGRQ activity score	25.47 ± 18.90	26.65 ± 23.46	36.35 ± 23.28	53.33 ± 18.04$^{*,\#,\&}$	0.006
SGRQ impact score	10.61 ± 11.88	18.29 ± 17.41	25.64 ± 13.38*	66.40 ± 14.40$^{*,\#,\&}$	< 0.001
SGRQ symptoms score	19.44 ± 13.70	26.65 ± 23.46	39.29 ± 21.78*	63.00 ± 14.74$^{*,\#,\&}$	< 0.001
Total score	17.00 ± 13.86	25.29 ± 20.33	32.53 ± 16.47*	58.17 ± 14.11$^{*,\#,\&}$	< 0.001

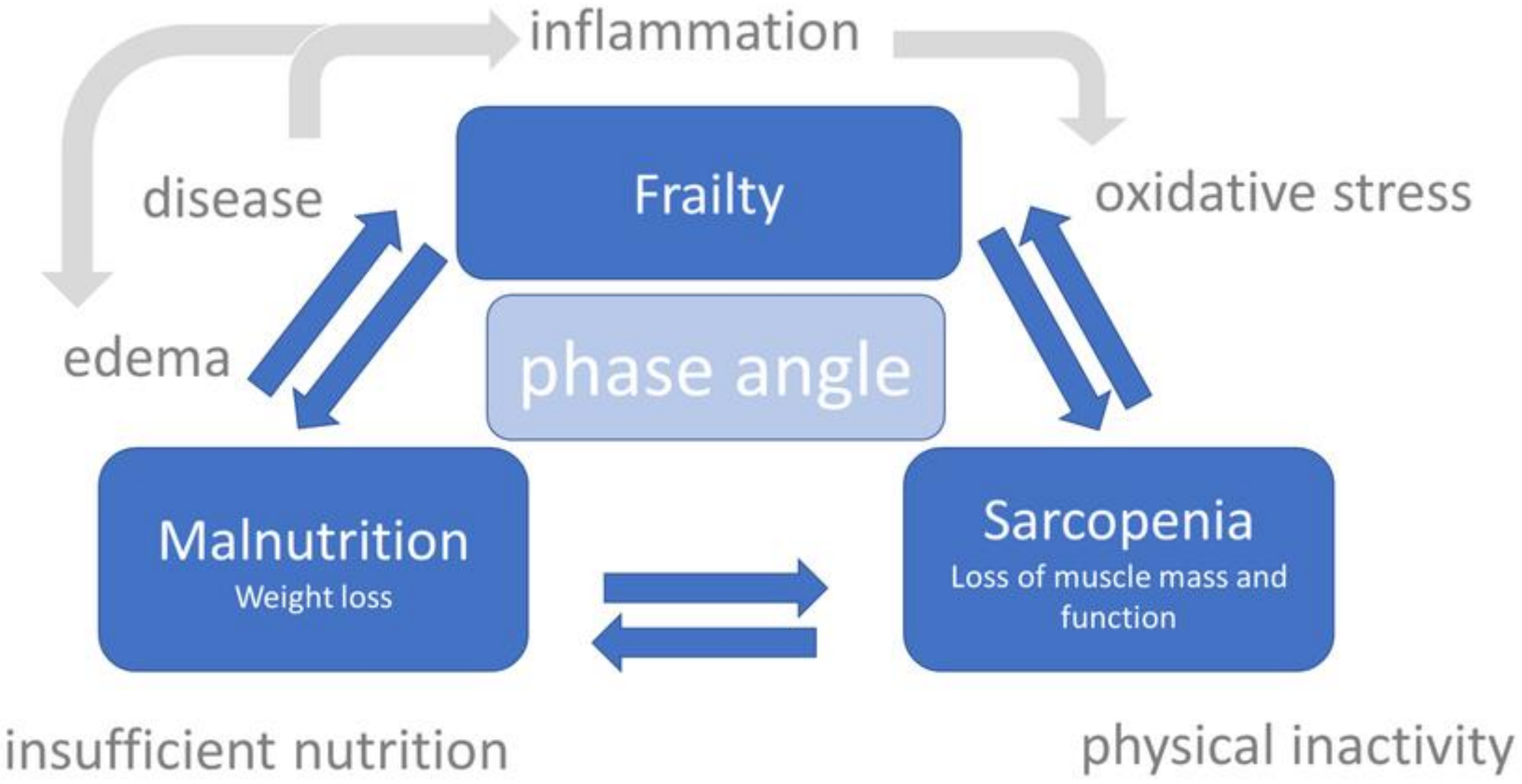




Curr Obes Rep **13**, 532–544 (2024)

Frailty, Sarcopenia

Malnutrition, Sarcopenia, and Frailty



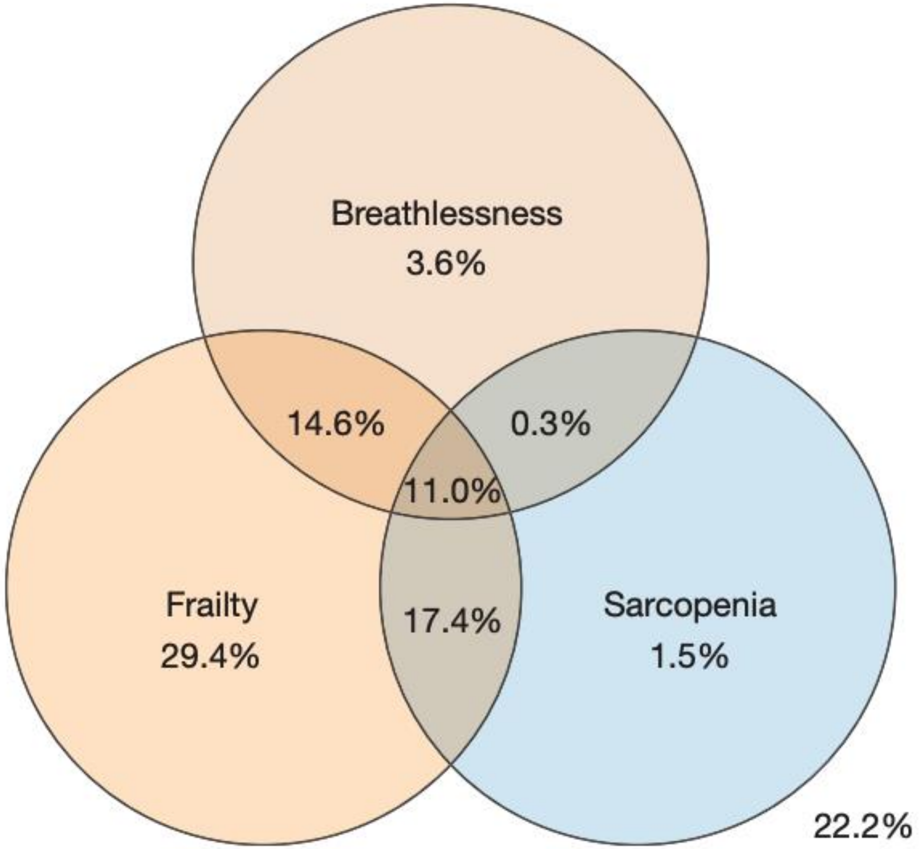
Rev Endocr Metab Disord **24**, 429–437 (2023)

Frailty, Sarcopenia → Dyspnea

Breathlessness, Frailty, and Sarcopenia in Older Adults

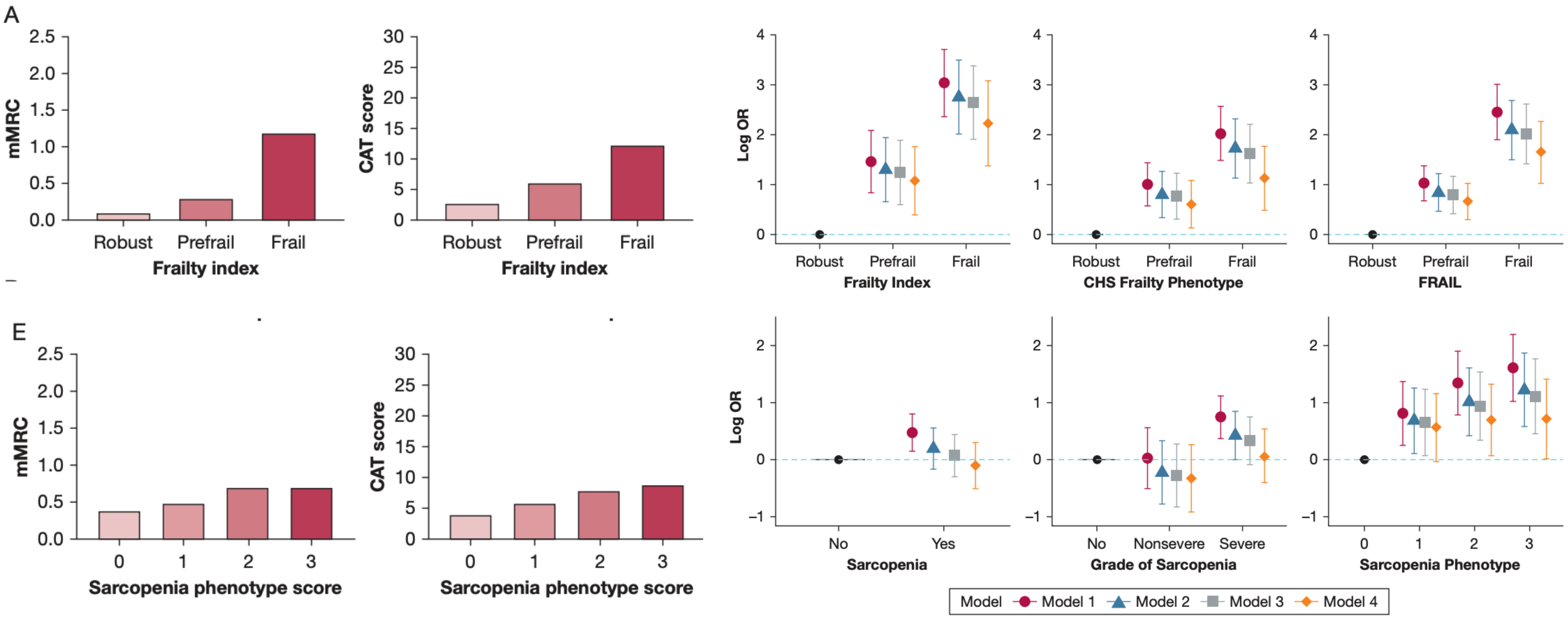
Check for updates

Tai Joon An, MD, PhD; Jihye Lim, MD, PhD; H
Ji Yeon Baek, MD, PhD; Eunju Lee, MD, PhD;



CHEST 2024; 166(6):1476-1486

Frailty, Sarcopenia → Dyspnea



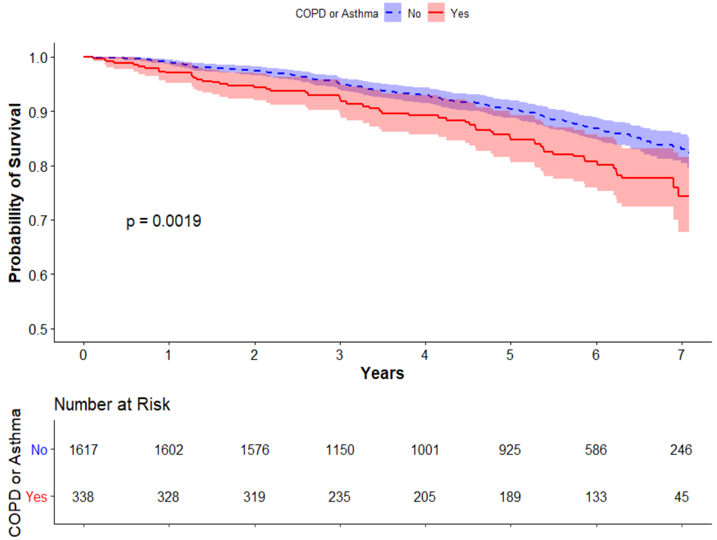
CHEST 2024; 166(6):1476-1486

COPD, Asthma → Frailty, Sarcopenia

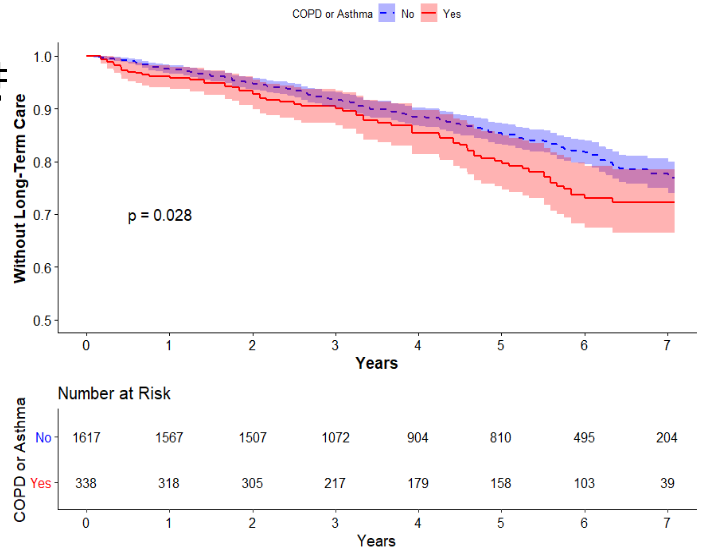
ASPRA 평창군 노인 코호트: COPD/Asthma No vs Yes

	Crude		Adjusted	
	OR	p-value	OR	p-value
CHS Frailty	1.64 (1.17-2.29)	0.003	1.38 (0.93-2.05)	0.107
CHS Pre-Frail	1.11 (0.83-1.49)	0.495	1.04 (0.74-1.45)	0.83
CHS Robust	Ref			
KFRAIL Frailty	1.79 (1.29-2.49)	<0.001	1.99 (1.30-3.05)	0.002
KFRAIL Pre-Frail	1.74 (1.33-2.27)	<0.001	1.66 (1.19-2.31)	0.003
KFRAIL Robust	Ref			
Frailty Index - Frailty	2.21 (1.66-2.96)	<0.001	2.11 (1.41-3.17)	<0.001
Frailty Index - Pre-Frail	1.74 (1.29-2.36)	<0.001	1.81 (1.25-2.63)	0.002
Frailty Index - Robust	Ref			

사망



장기요양



Unpublished

In COPD, Asthma + Frailty, Sarcopenia

ASPRA 평창군 노인 코호트 + COPD/Asthma: Sarcopenia vs No, Frailty vs. Robust

	No sarcopenia	Sarcopenia		Robust	Pre-frail	Frail	
n	219	113	P-value	108	158	72	P-value
Mod AE count	17.24 (22.48)	51.89 (44.34)	0.013	25.00 (26.83)	41.33 (44.09)	9.57 (9.47)	0.152
Sev AE count	6.92 (5.87)	4.79 (5.47)	0.348	6.88 (5.46)	6.46 (6.48)	2.17 (0.98)	0.23
Pneumonia OPD	45 (20.5)	38 (33.6)	0.013	10 (9.3)	21 (13.3)	6 (8.3)	0.425
Pneumonia Adm	31 (14.2)	31 (27.4)	0.005	12 (11.1)	33 (20.9)	19 (26.4)	0.026
AE (7Y)	82 (37.4)	47 (41.6)	0.538	31 (28.7)	64 (40.5)	35 (48.6)	0.021
Survival (7Y)	24 (11.0)	31 (27.4)	<0.001	12 (11.1)	26 (16.5)	20 (27.8)	0.014

Unpublished

Summary - 1

- Nutrition is important.
- Malnutrition: over- , under-
- Chronic Respiratory disease = more vulnerable to malnutrition
  - Increased REE, increased TEF, decreased appetite
  - Weight Loss → Loss of Skeletal muscle, Loss of Fat-free muscle
  - Weight Gain → Paradox, Poor in severe (comorbidities, resistin, inflammation)
  - Sarcopenia, Frailty
    - Another geriatric syndrome of lung → Poor outcomes: AE, pneumonia, Mortality

Overview of Today's Talk

- Nutrition - Malnutrition
- **Carbohydrate, Lipid, and Protein**
- Finding High Risk Patients and How to?

Are Extra Calories Harmful?

만성폐쇄성폐질환 환자에서 열량섭취와 폐기능지표와의 상관관계

[1]분당서울대학교병원 폐센터, 서울대학교 의과대학 내과학교실 및 폐연구소, [2]분당서울대학교병원 영양과, [3]경희대학교 동서학원 의학영양학과
윤호일[1], 박영미[2], 조여원[3], 강영애[1], 권성연[1], 이재호[1], 이춘택[1]

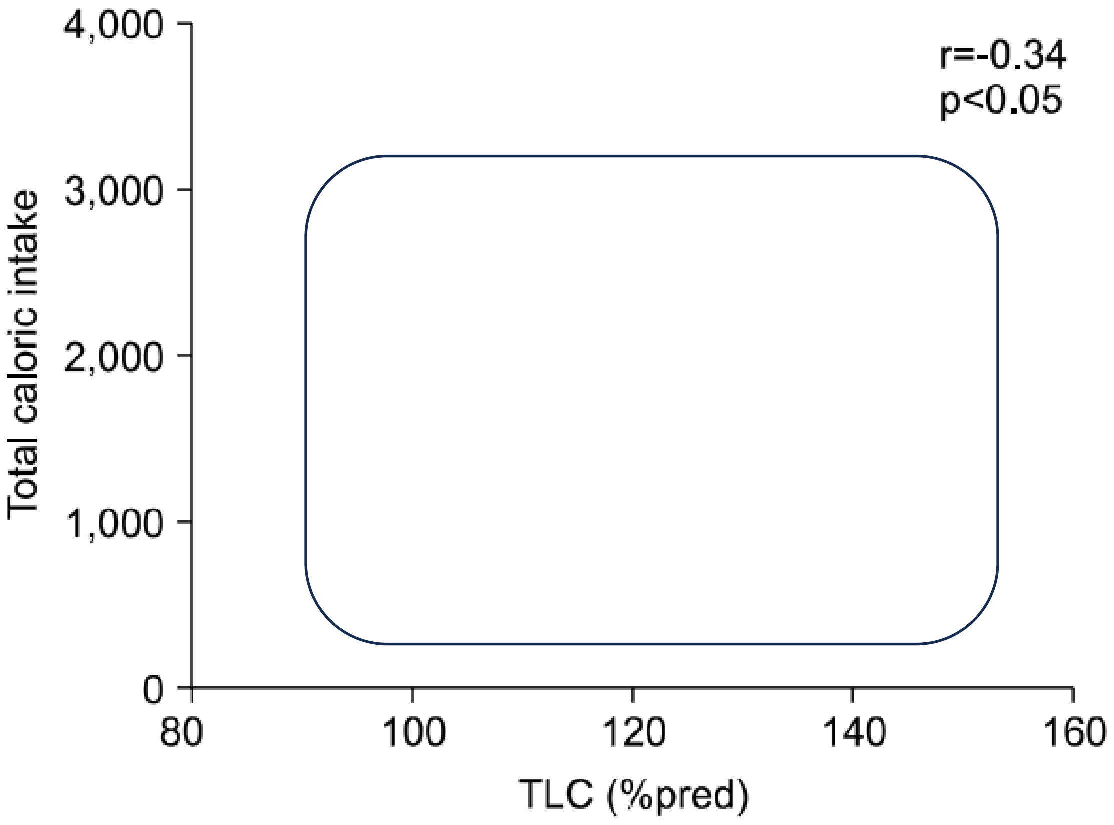
Table 1. Characteristics of subjects

Total number of subjects	44
Sex ratio (M:F)	40:4 (10:1)
Age (years, mean±SD)	68.7±8.7

Table 2. Evaluated caloric intake

Total caloric intake	1,588.0±455.9 (Kcal/day)
Intake of calories from protein	66.2±23.0 (Kcal/day)
Intake of calories from carbohydrate	237.5±64.8 (Kcal/day)
Intake of calories from lipid	36.6±15.0 (Kcal/day)

Values are mean±standard deviation.



Tuberc Respir Dis 2008;65:385-389

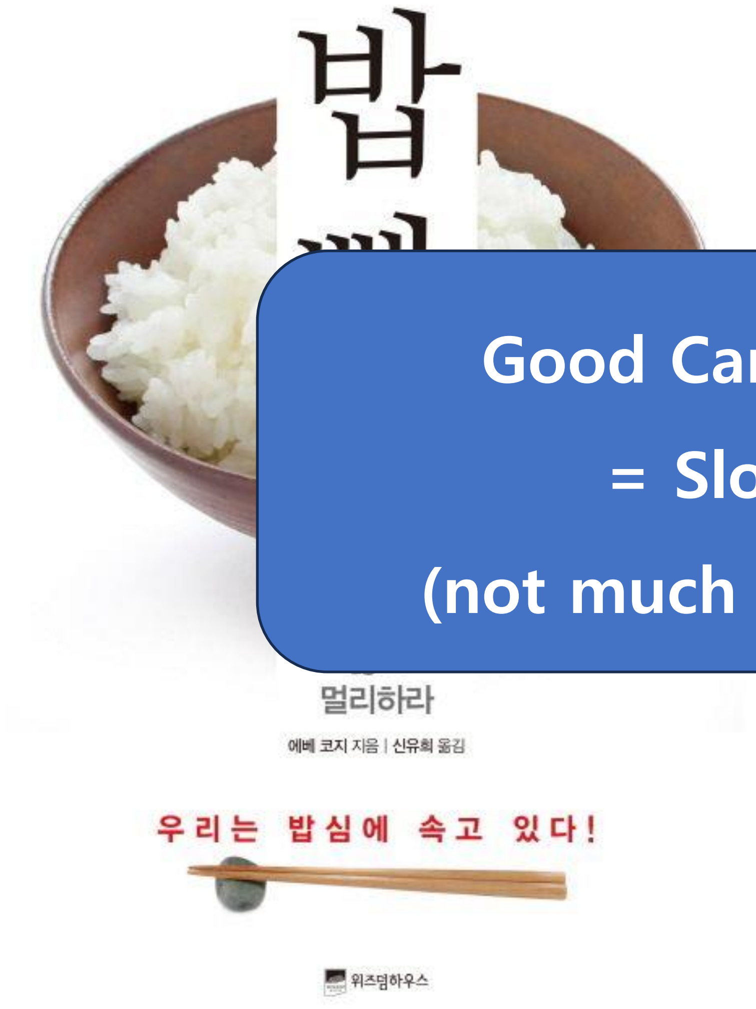
탄.단.지.

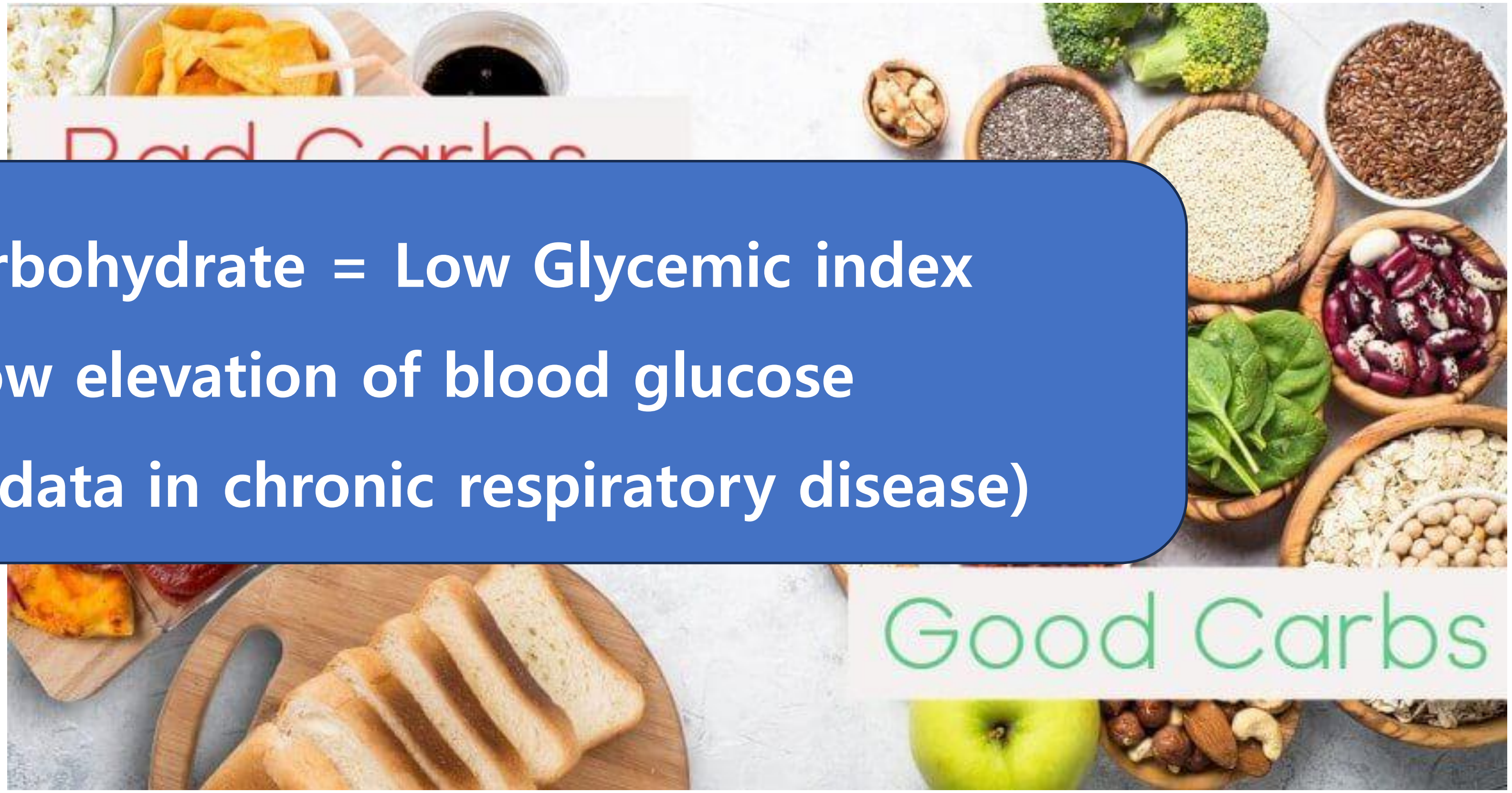
- 한국의 현실
  - 탄수화물 4 kcal/g (45-65%)
    - 연령별 섭취량의 차이가 없음.
  - 단백질 4 kcal/g (10-35%)
    - 동물성 단백질%: 38% vs. 55% (30-50대)
  - 지방 9 kcal/g (20-35%)
    - 지방급원 에너지%: 65세 이상에서 20 이하

다양한 식단의 종류

	탄수화물	지방	단백질	대표 이름	설명
저탄고지 (LCHF)	↓ 낮음	↑ 높음	중간~높음	LCHF, 케토제닉(Keto)	탄수화물 제한 (보통 <50g/일), 지방을 주요 에너지원으로 활용. 케톤체 생성 유도. 체중 감량, 혈당 조절 효과 있음.
저탄저지 (Low Carb Low Fat)	↓ 낮음	↓ 낮음	↑ 높음	고단백 식단(High-protein diet)	전체 칼로리를 낮추며 단백질 위주로 구성. 체중 감량과 근육 보존에 목적. 지속성은 낮을 수 있음.
고탄저지 (High Carb Low Fat)	↑ 높음	↓ 낮음	중간	전통식, 고탄수화물 채식, Ornish diet	식물성 식단 중심. 과일, 곡류, 채소 위주. 지방을 제한함으로써 심혈관 질환 예방 목적.
고탄고지 (High Carb High Fat)	↑ 높음	↑ 높음	중간	서구형 식단 (Western diet)	정제 탄수화물 + 포화지방 섭취 ↑. 비만, 대사질환과 연관된 식단. 건강에는 부정적.
중탄중지 (Balanced)	중간	중간	중간	지중해 식단, DASH diet	균형 잡힌 영양소. 과일·채소·통곡물, 불포화지방(올리브유, 견과류), 적당한 단백질 포함. 심혈관, 당뇨 예방에 효과적.

Carbohydrate: GOOD or BAD



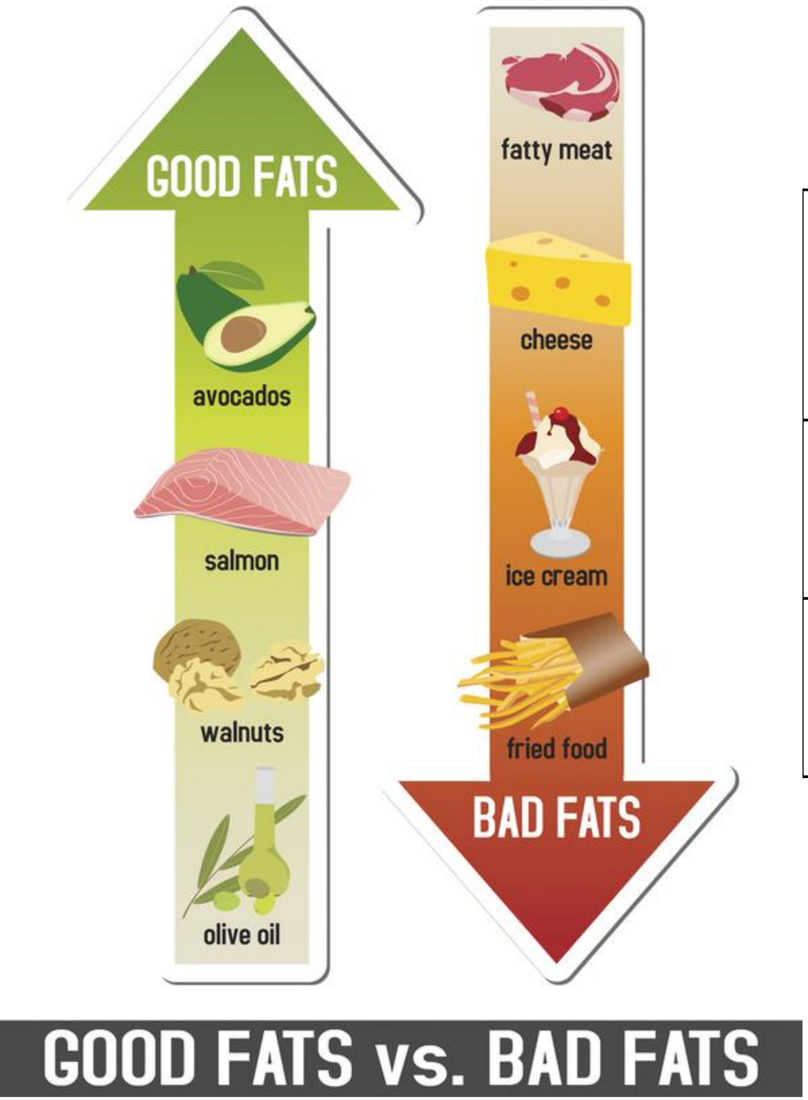


Good Carbohydrate = Low Glycemic index

= Slow elevation of blood glucose

(not much data in chronic respiratory disease)

Fat: GOOD or BAD



OLFD	Overall Low-Fat Diet score	총 에너지 섭취 중 **지방 비율이 낮고**, 탄수화물·단백질 비율이 높은 식사를 기반으로 산출된 점수.
ULFD	Unhealthy Low-Fat Diet score	**정제 탄수화물, 동물성 단백질, 포화지방산**이 높은 **질 낮은 저지방 식이** 점수.
HLFD	Healthy Low-Fat Diet score	**복합 탄수화물, 식물성 단백질, 불포화지방산** 중심의 **건강한 저지방 식이** 점수.

IJCOPD 2024:19 2443–2455

Glycemic Quality Matters

SYSTEMATIC REVIEWS AND META-ANALYSES

Carbohydrate quality, glycemic index, glycemic load and cardiometabolic risks in the US, Europe and Asia: A dose–response meta-analysis

Dale S. Hardy [a,*], Jane T. Garvin [b], Hongyan Xu [c]

Table 3 Pooled hazard ratios of dietary variables by disease outcomes in the whole sample in the US, Europe, and Asia.

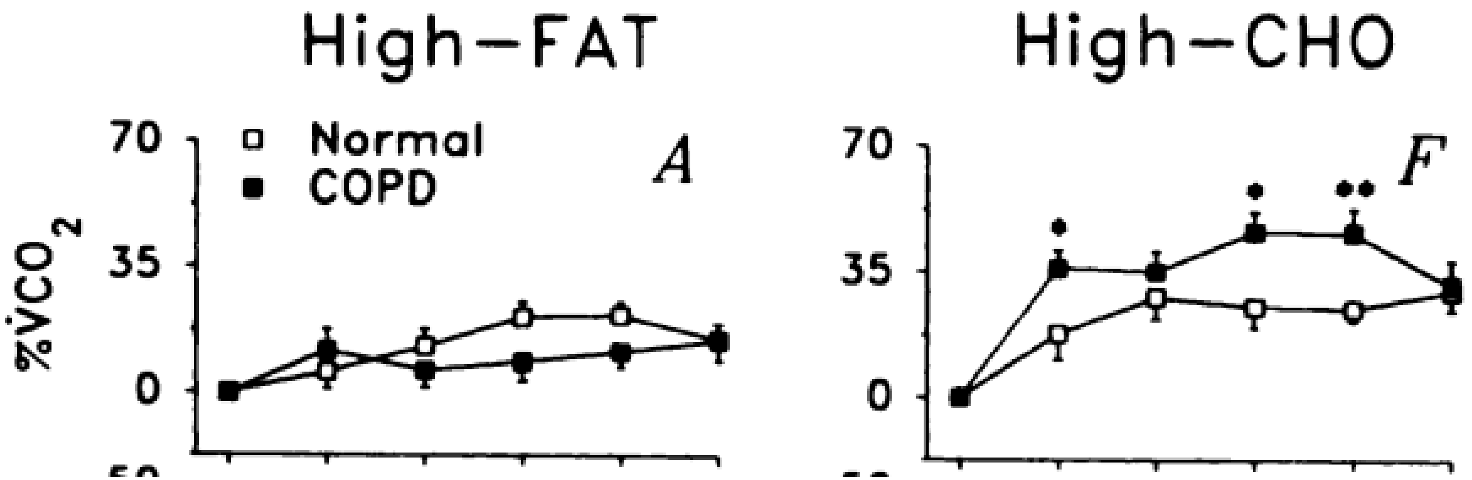
	Pooled Hazard Ratio (95% Confidence Interval)			
	T2DM	CHD	Stroke	Mortality
		Asia		
Glycemic index	**1.25 (1.02, 1.53)**	1.17 (0.81, 1.69)[b]	**1.19 (1.04, 1.36)**[b]	1.19 (0.77, 1.84)
Glycemic load	**1.37 (1.17, 1.60)**	1.87 (0.98, 3.55)[b]	**1.26 (1.04, 1.53)**[b]	1.23 (0.87, 1.73)
GI and high BMI	**1.28 (1.05, 1.56)**			0.88 (0.41, 1.91)[b]
GL and high BMI	**1.52 (1.22, 1.89)**[a]			0.98 (0.48, 1.98)[b]
CHO	**1.28 (1.09, 1.50)**[a]	**2.88 (1.44, 5.78)**[b]	1.16 (0.92, 1.47)[b]	1.07 (0.72, 1.58)
High glycemic CHO	**1.78 (1.48, 2.15)**[a]	**1.79 (1.02, 3.16)**[b]	**1.19 (1.01, 1.42)**[b]	1.19 (0.88, 1.62)
Dietary fiber	0.99 (0.59, 1.66)[a]			
Cereal fiber				

NMCD (2020) 30, 853-871

Why is a High-Carbohydrate diet problematic?

The Effects of High-fat and High-carbohydrate Diet Loads on Gas Exchange and Ventilation in COPD Patients and Normal Subjects*

Cheng-Deng Kuo, M.D., Ph.D.; Guang-Ming Shiao, M.D., F.C.C.P.;† and Jiunn-Der Lee, M.D.

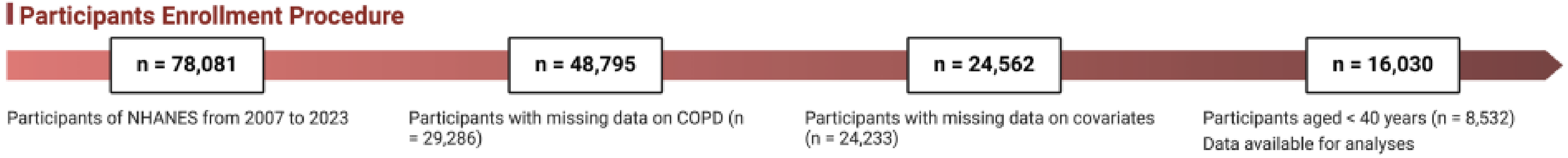


Chest 1993. 104:189-196

Carbohydrate Quantity (Low-Carbo Diet)

Low-carbohydrate diet score and chronic obstructive pulmonary disease: a machine learning analysis of NHANES data

Xin Zhang[1], Jipeng Mo[1], Kaiyu Yang[1], Tiewu Tan[2], Cuiping Zhao[3]* and Hui Qin[2]*



- PSM : 1882 vs 1882 명

- LCD (Low Carbohydrate diet)
  - Convert to kcal → % of total energy

- Outcome
  - COPD prevalence

Points	Carbohydrate/ total energy %	Protein/ total energy %	Fat/ total energy %
0	> 56.0	<14.1	<26.0
1	51.6-56.0	14.1-15.6	26.0-29.5
2	49.1-51.5	15.7-16.6	29.6-31.6
3	47.1-49.0	16.7-17.3	31.7-33.2
4	45.2-47.0	17.4-18.0	33.3-34.7
5	43.3-45.1	18.1-18.7	34.8-36.1
6	41.2-43.2	18.8-19.4	36.2-37.7
7	38.8-41.1	19.5-20.3	37.8-39.5
8	35.4-38.7	20.4-21.5	39.6-42.0
9	29.3-35 .3	21.6-24.0	42.1-46.9
10	<29.3	>24.0	>46.9

Front. Nutr. 11:1519782.

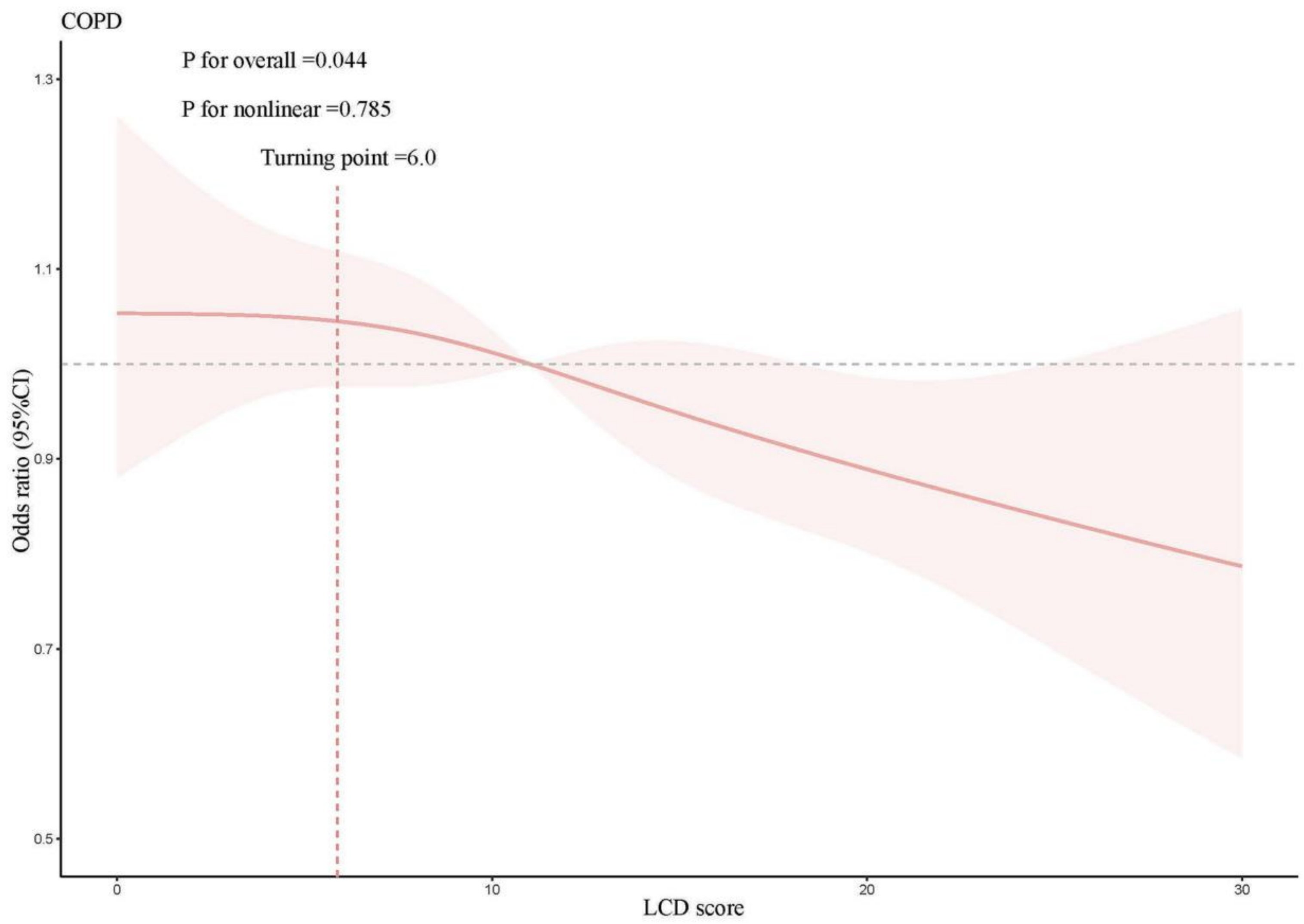
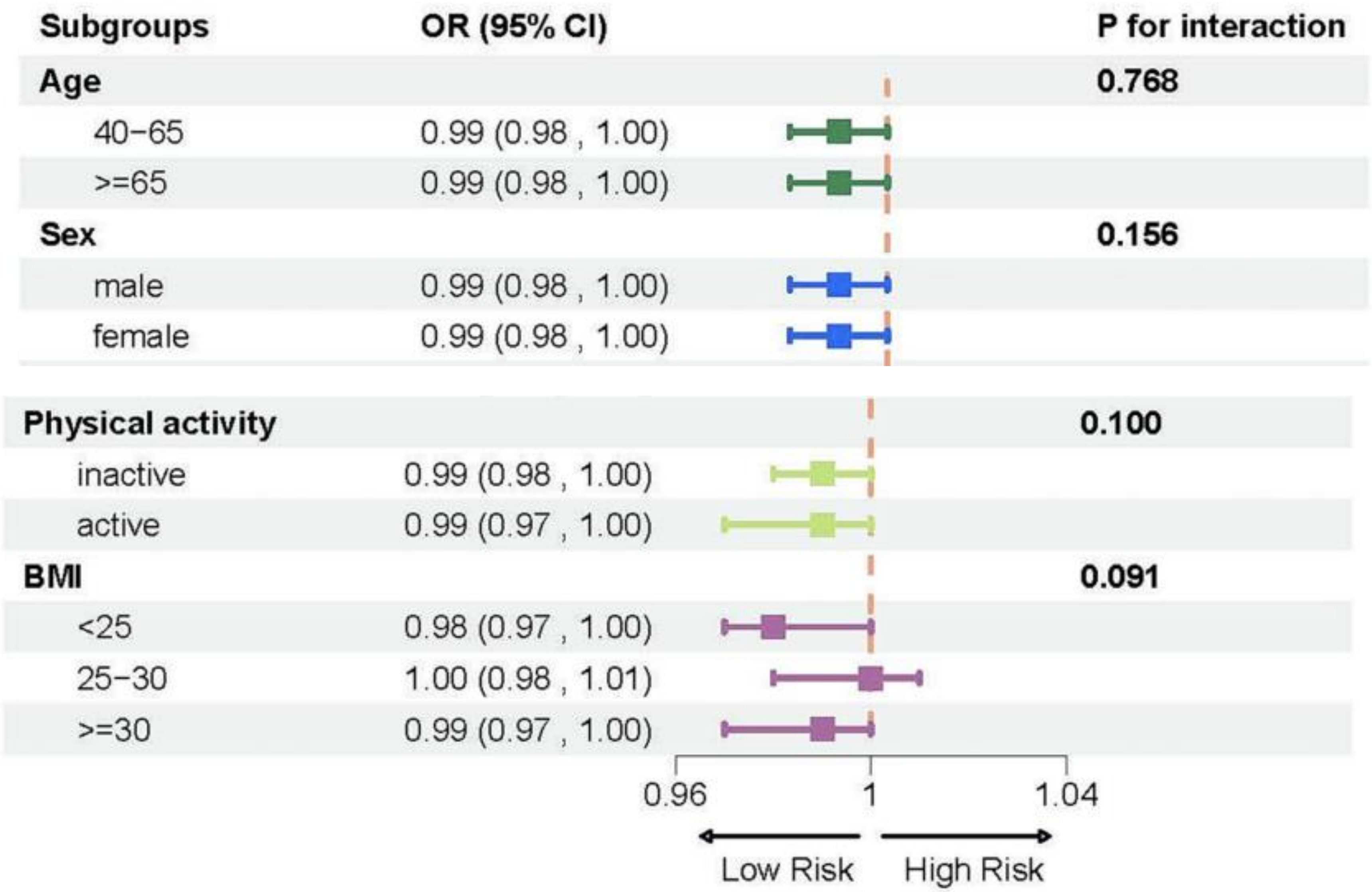


FIGURE 2
Results of the RCS analysis, adjusted for age, sex, race/ethnicity, educational level, marital status, PIR, BMI, waist circumference, WHtR, physical activity, smoking status, hypertension, diabetes, congestive heart failure, coronary heart disease, heart disease, stroke, magnesium intake, calcium intake, vitamin D intake.

Front. Nutr. 11:1519782.



Front. Nutr. 11:1519782.

Carbohydrate Quality

Contents lists available at ScienceDirect
Clinical Nutrition
journal homepage: http://www.elsevier.com/locate/clnu

Original article

Quantity and quality of dietary carbohydrates, low-grade inflammation, and risk of chronic obstructive pulmonary disease and lung function

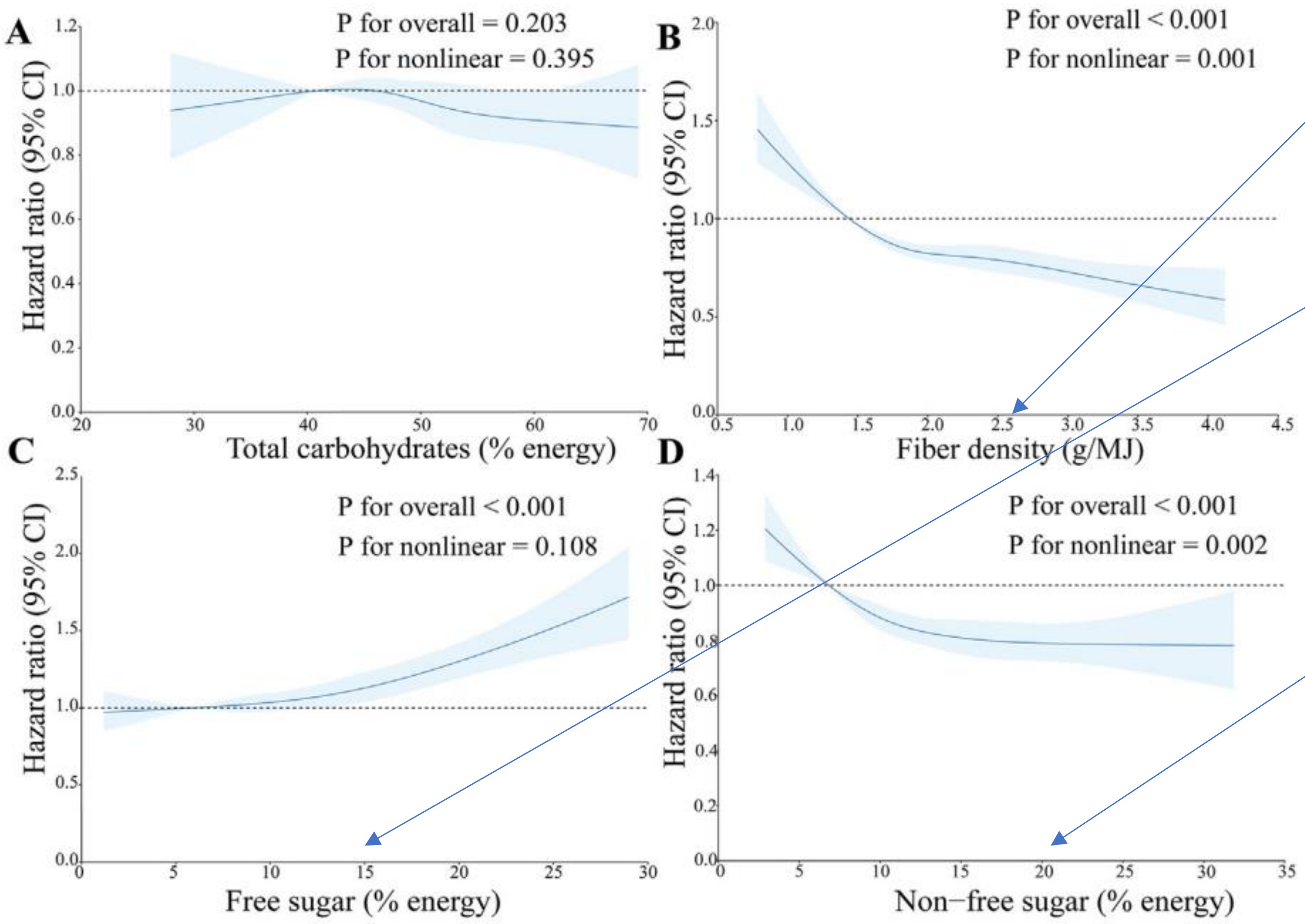
Fei Fang [a], Ji-Mei Gu [a], Yu-Wen Qian [a], Xiao-Ping Shao [a], Zhong-Yue Liu [a], Yang-Yang Ge [b, **], Guo-Chong Chen [a, *]

[a] *The Fourth Affiliated Hospital of Soochow University, Department of Nutrition and Food Hygiene, School of Public Health, Suzhou Medical College of Soochow University, Suzhou, China*
[b] *Department of Radiation Oncology, The Affiliated Tumor Hospital of Nantong University, Nantong Tumor Hospital, Nantong, China*

- **UK biobank 2006~2010**
- **502,411 participants**
- **24h dietary assessment (+) – Oxford WebQ**
- **Outcome**
  - **Risk of COPD**
  - **FEV1**

Clinical Nutrition 45 (2025)

Carbohydrate Quality and COPD



Fiber density: 에너지 대비 식이섬유 함량

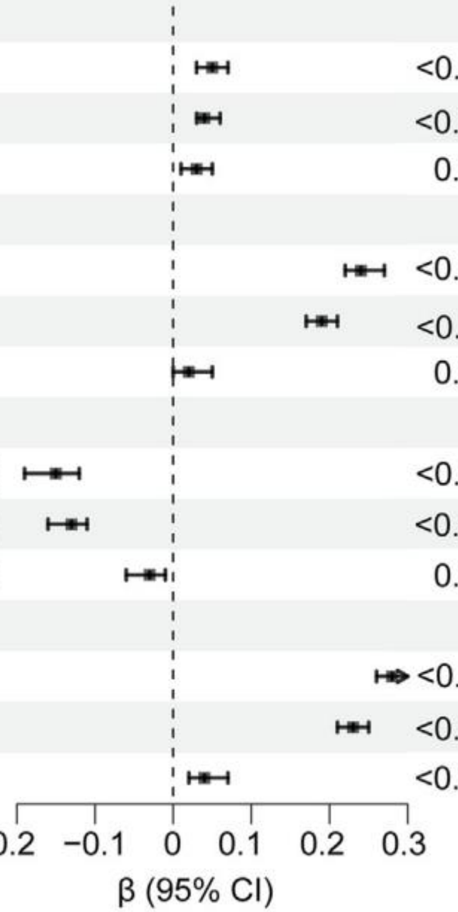
Free sugar
설탕, 포도당, 과당 등 **첨가당 (Added sugar)**
- 꿀, 시럽, 아가베 시럽
- 과일/채소에서 짜낸 **주스의 당**
- 과일퓨레나 농축액 등에서 **자유롭게 존재하는 당**

Non-free sugar
통과일, 채소에 자연적으로 들어 있는 당
- 우유에 들어 있는 유당 (lactose)

Clinical Nutrition 45 (2025)

Carbohydrate Quality and COPD

Carbohydrate intake	β (95% CI)	*P*-value
Total carbohydrates (% energy)		
FVC (dL)	0.05 (0.03, 0.07)	<0.001
FEV_1 (dL)	0.04 (0.03, 0.06)	<0.001
FEV_1/FVC (%)	0.03 (0.01, 0.05)	0.006
Fiber density (g/MJ)		
FVC (dL)	0.24 (0.22, 0.27)	<0.001
FEV_1 (dL)	0.19 (0.17, 0.21)	<0.001
FEV_1/FVC (%)	0.02 (0.00, 0.05)	0.042
Free sugar (% energy)		
FVC (dL)	−0.15 (−0.19, −0.12)	<0.001
FEV_1 (dL)	−0.13 (−0.16, −0.11)	<0.001
FEV_1/FVC (%)	−0.03 (−0.06, −0.01)	0.017
Non−free sugar (% energy)		
FVC (dL)	0.28 (0.26, 0.31)	<0.001
FEV_1 (dL)	0.23 (0.21, 0.25)	<0.001
FEV_1/FVC (%)	0.04 (0.02, 0.07)	<0.001



Clinical Nutrition 45 (2025)

Carbohydrate Quality and COPD

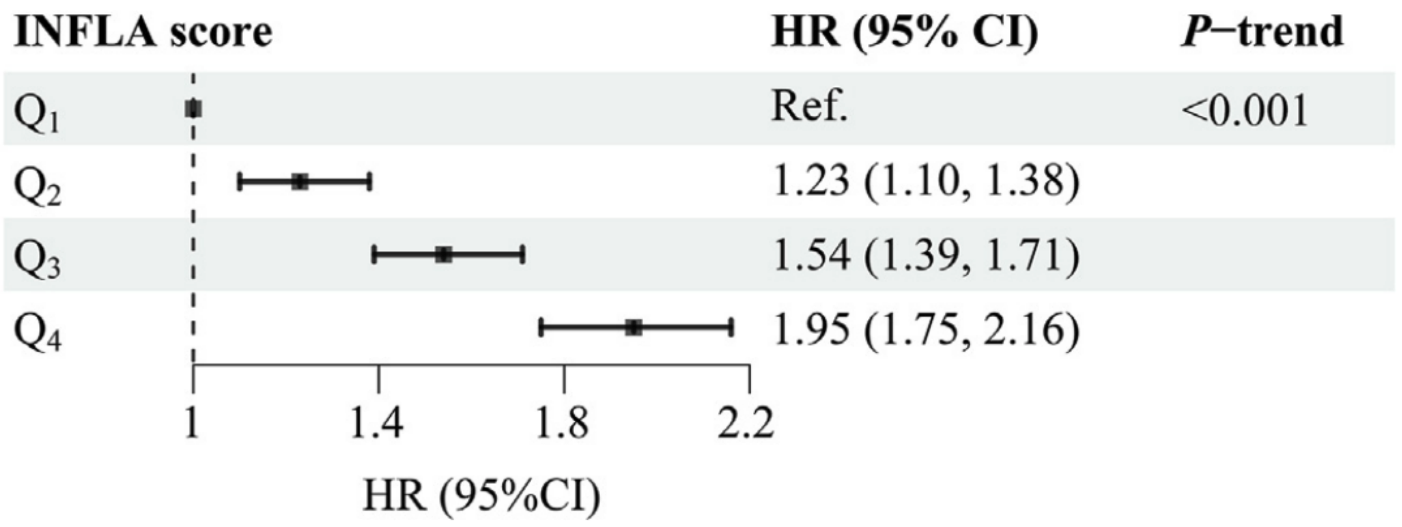


Fig. 3. Associations between INFLA score and COPD risk. Results were adjusted for age, sex, race/ethnicity, Townsend deprivation index, education levels, physical activity, smoking status, alcohol intake, diabetes, hypertension, asthma, CVD, cancer, family history of chronic lung diseases, BMI, total energy intake, total protein intake (% of energy), and the ratio of dietary PUFAs/SFAs. Abbreviations: CI confidence intervals; COPD chronic obstructive pulmonary disease; HR Hazard Ratios; INFLA score Low-grade chronic inflammation score; Q1 the first quartile; Q2 the second quartile; Q3 the third quartile; Q4 the fourth quartile.

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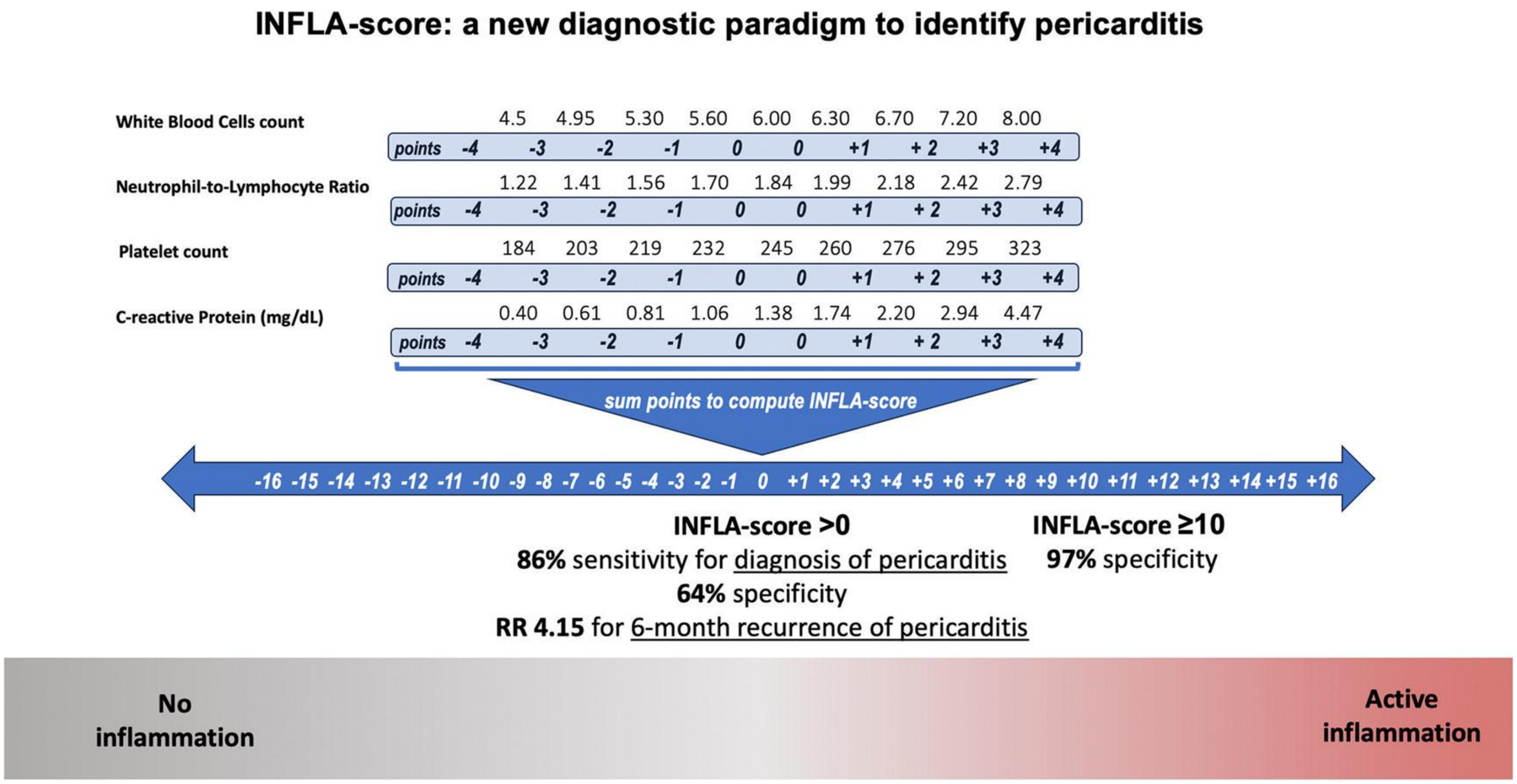
Carbohydrate Quality and COPD



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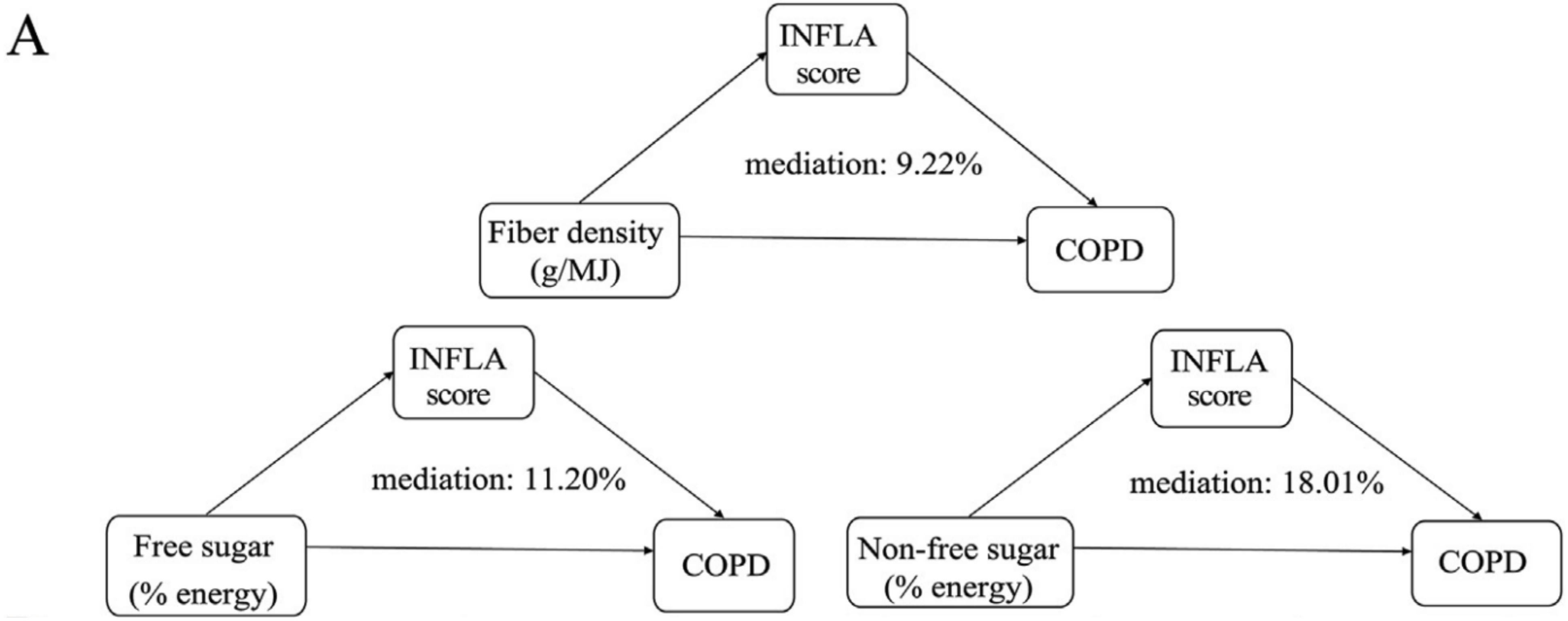
Carbohydrate Quality and COPD



Clinical Nutrition 45 (2025)

Low Carbo, Low fat

International Journal of Chronic Obstructive Pulmonary Disease Dovepress

Open Access Full Text Article ORIGINAL RESEARCH

Effects of Low-Carbohydrate and Low-Fat Diets on Morbidity and Mortality of COPD

, Yan Wang, Xiangyu Shi,

Table 3 Associations of LCD and LFD Scores with All-Cause Mortality Among People with COPD[a]

	Tertile 1	Tertile 2	Tertile 3	Per 5-Point Increase	*P*-trend
Overall LCD					
Model 1[b]	Reference	0.82 (0.47–1.42, *P* = 0.481)	1.20 (0.70–2.05, *P* = 0.514)	1.10 (0.95–1.27, *P* = 0.192)	0.423
Model 2[c]	Reference	0.94 (0.53–1.66, *P* = 0.828)	1.30 (0.74–2.27, *P* = 0.360)	1.12 (0.97–1.30, *P* = 0.119)	0.313
Unhealthful LCD					
Model 1[b]	Reference	1.43 (0.80–2.53, *P* = 0.226)	2.18 (1.28–3.73, *P* = 0.004)	1.24 (1.06–1.46, *P* = 0.009)	0.003
Model 2[c]	Reference	1.55 (0.87–2.76, *P* = 0.138)	2.30 (1.23–4.31, *P* = 0.009)	1.21 (1.03–1.43, *P* = 0.021)	0.009
Healthful LCD					
Model 1[b]	Reference	0.86 (0.51–1.46, *P* = 0.588)	0.68 (0.36–1.29, *P* = 0.243)	0.97 (0.82–1.15, *P* = 0.737)	0.244
Model 2[c]	Reference	0.99 (0.57–1.73, *P* = 0.976)	0.91 (0.46–1.77, *P* = 0.770)	1.04 (0.87–1.24, *P* = 0.659)	0.777
Overall LFD					
Model 1[b]	Reference	0.92 (0.58–1.48, *P* = 0.745)	0.72 (0.37–1.41, *P* = 0.341)	0.94 (0.79–1.13, *P* = 0.520)	0.356
Model 2[c]	Reference	0.86 (0.52–1.41, *P* = 0.543)	0.70 (0.34–1.41, *P* = 0.312)	0.92 (0.76–1.10, *P* = 0.360)	0.307
Unhealthful LFD					
Model 1[b]	Reference	1.14 (0.69–1.89, *P* = 0.601)	1.19 (0.56–2.54, *P* = 0.645)	1.06 (0.88–1.29, *P* = 0.529)	0.584
Model 2[c]	Reference	1.09 (0.66–1.81, *P* = 0.736)	1.11 (0.52–2.40, *P* = 0.784)	1.02 (0.83–1.24, *P* = 0.867)	0.739
Healthful LFD					
Model 1[b]	Reference	0.64 (0.40–1.01, *P* = 0.056)	0.43 (0.23–0.80, *P* = 0.008)	0.77 (0.65–0.90, *P* = 0.001)	0.005
Model 2[c]	Reference	0.70 (0.43–1.12, *P* = 0.134)	0.47 (0.24–0.90, *P* = 0.023)	0.79 (0.67–0.94, *P* = 0.006)	0.019

Notes: [a]: Cox proportional hazards models were used to estimate the HRs and 95% CIs of all-cause mortality according to tertiles of LCD and LFD scores. [b]: Model 1 was adjusted for age. [c]: Model 2 was further adjusted for sex, race/ethnicity, BMI, family income to poverty ratio, smoking, education, history of cancer, hypertension, history of heart disease, and total calorie intake.

Abbreviations: LCD, low-carbohydrate diet; LFD, low-fat diet.

IJCOPD 2024:19 2443–2455

Low Carbo, High Fat: Ketogenic Diet

Low Carbo, High Fat: Ketogenic Diet

Case Report: Ketogenic Diet Is Associated With Improvements in Chronic Obstructive Pulmonary Disease

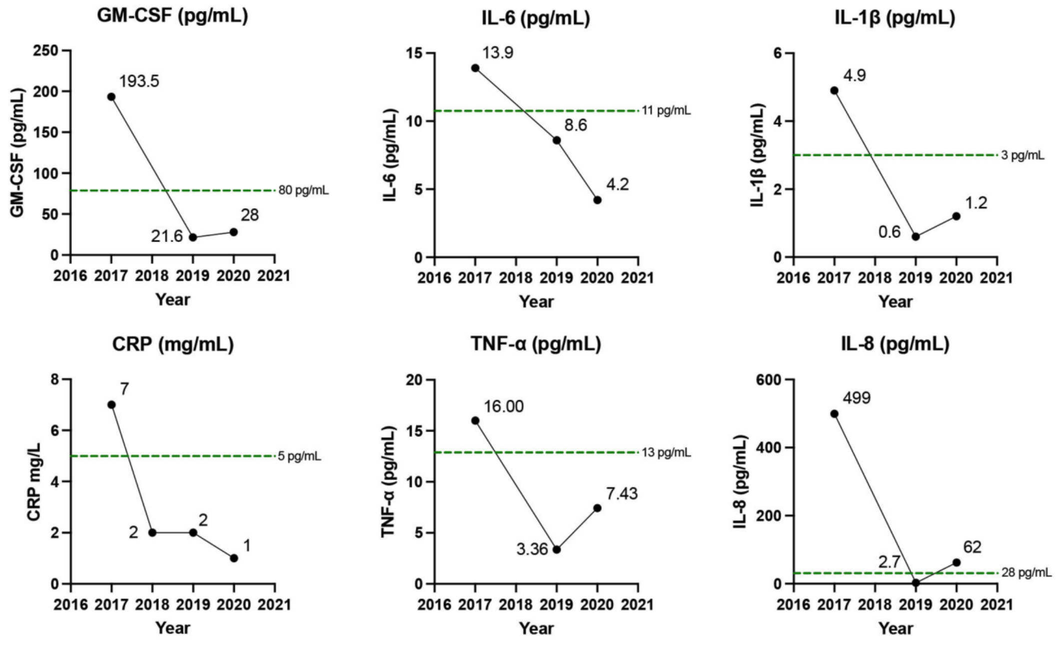
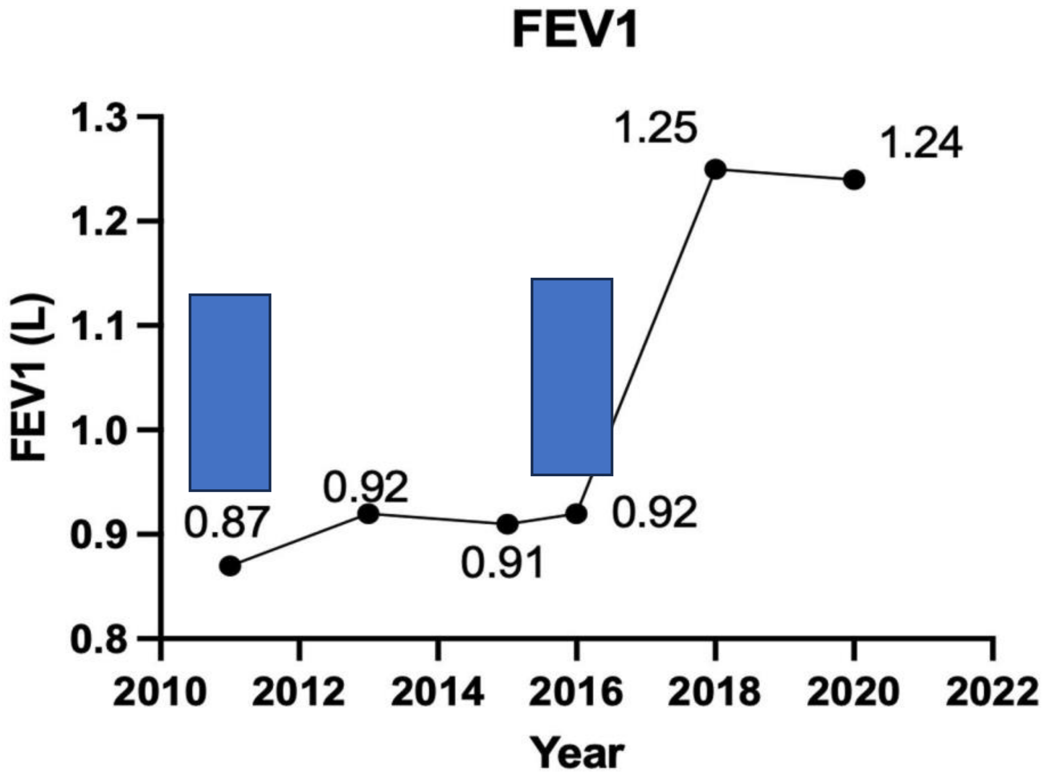


FIGURE 1 | Inflammatory biomarkers. Data represent C.A.'s inflammatory biomarkers prior to starting a ketogenic diet and at two time points, 2019 and 2020, after commencing the diet. Green dotted line represent the threshold of normal range for each biomarker. All markers improved on a ketogenic diet.

54세 (45세 진단) under ICSLABALAMA
BMI 29.4 -> 23.8



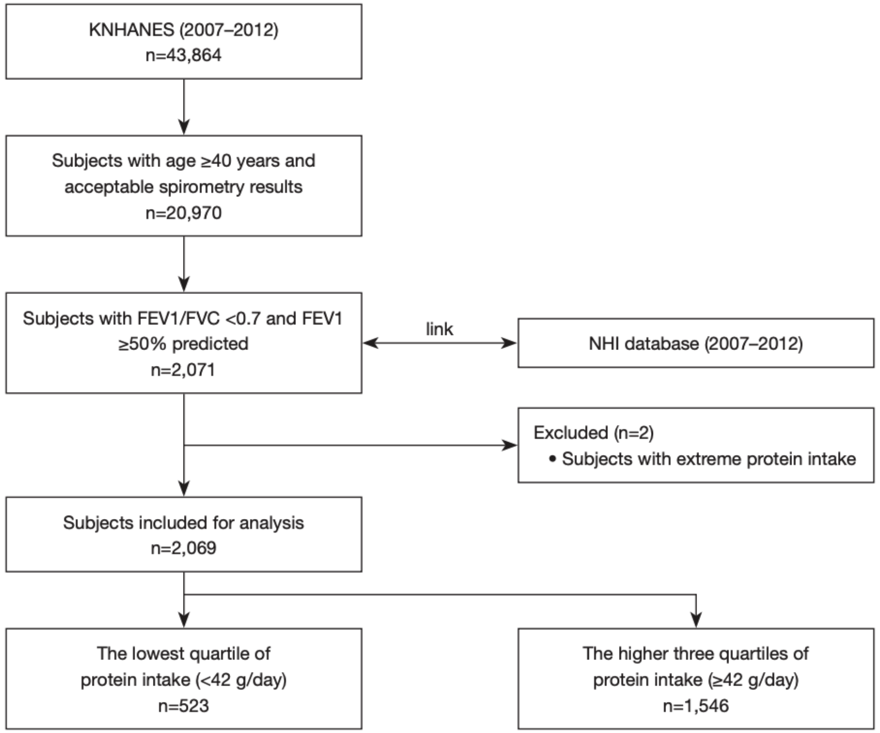
Front. Med. 8:699427

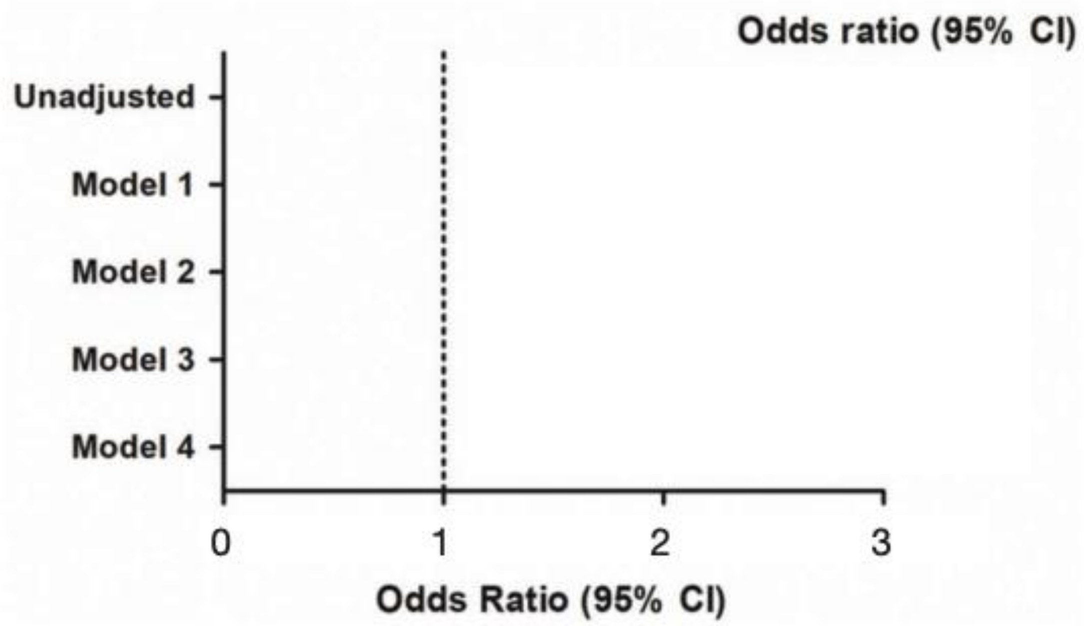
Low Protein → AECOPD

Original Article

Effect of low protein intake on acute exacerbations in mild to moderate chronic obstructive pulmonary disease: data from the 2007–2012 KNHANES

Sojung Park[1#], Seo Woo Kim[2#], Chin Kook Rhee[3], Kyungjoo Kim[3], Woo Jin Kim[4], Kwang Ha Yoo[5], Chang Youl Lee[6], Deog Kyeom Kim[7], Yong Bum Park[8], Ki-Suck Jung[9], Jin Hwa Lee[1]





Model 1: FEV1 % predicted-adjusted. Model 2: FEV1 % predicted and weight-adjusted. Model 3: FEV1 % predicted, weight, and smoking pack-years-adjusted. Model 4: FEV1 % predicted, weight, smoking pack-years, and household income-adjusted.

J Thorac Dis 2021;13(10):5592-5603

Protein: Whey Protein

- 치즈를 만들 때 생기는 유청에서 추출
- β-lactoglobulin, α-lactalbumin, serum albumin, immunoglobulins
- 필수아미노산, BCAA 포함 → 근육합성

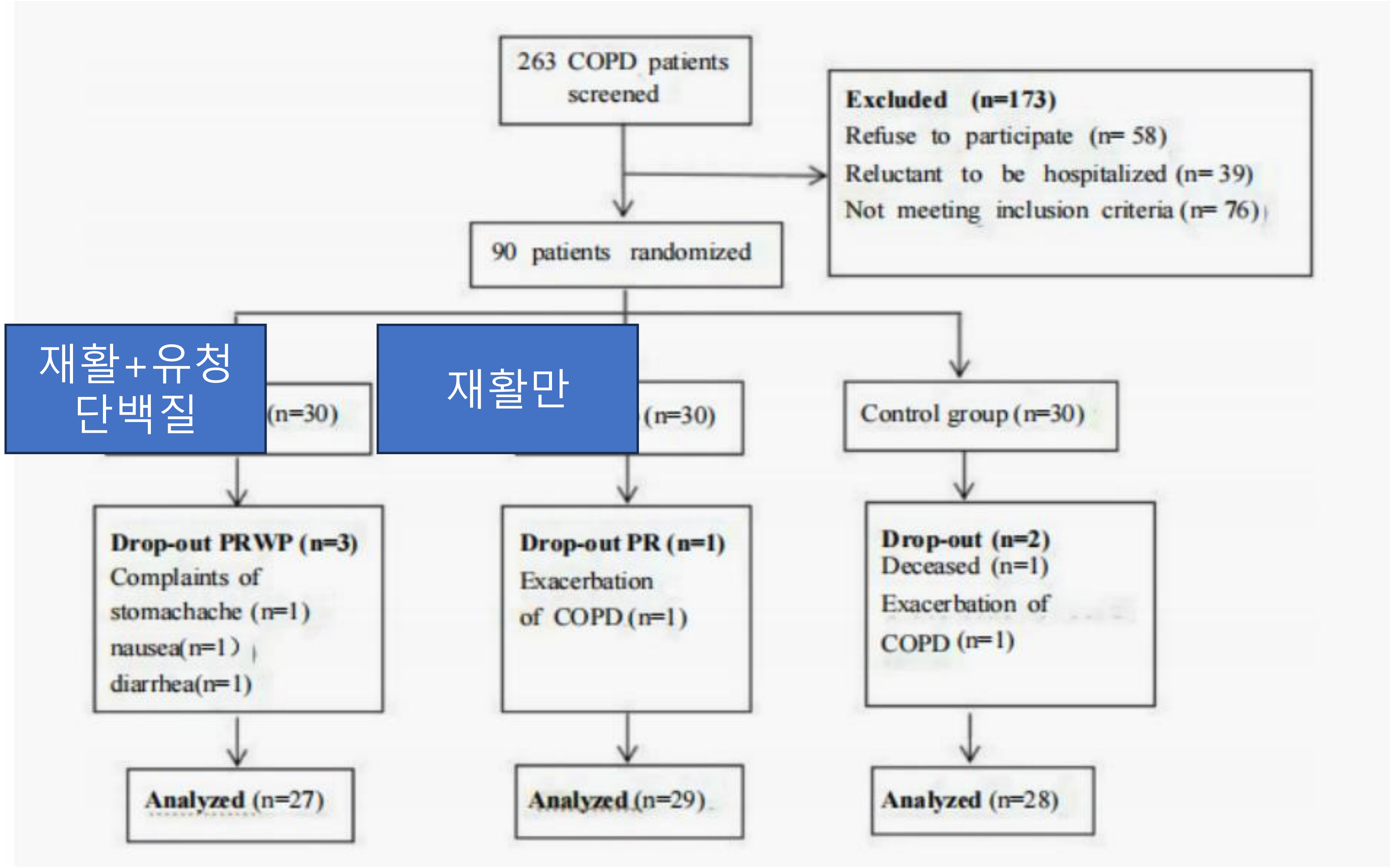
Protein: Whey Protein

Effects of whey protein complex combined with low-intensity exercise in elderly inpatients with COPD at a stable stage

Min Zong MM[1], Honghua Shen MD[2], Lei Ren MD[2], Tao Han MB[3], Jie Chen MD[4], Yanqiu Chen MB[1], Jiashuo Lu MSc[5], Yin Zhang MD[2], Shijie Li MB[1], Jianqin Sun MD[1]

Asia Pac J Clin Nutr 2023;32(4):375-382

Protein: Whey Protein



Asia Pac J Clin Nutr 2023;32(4):375-382

Protein: Whey Protein

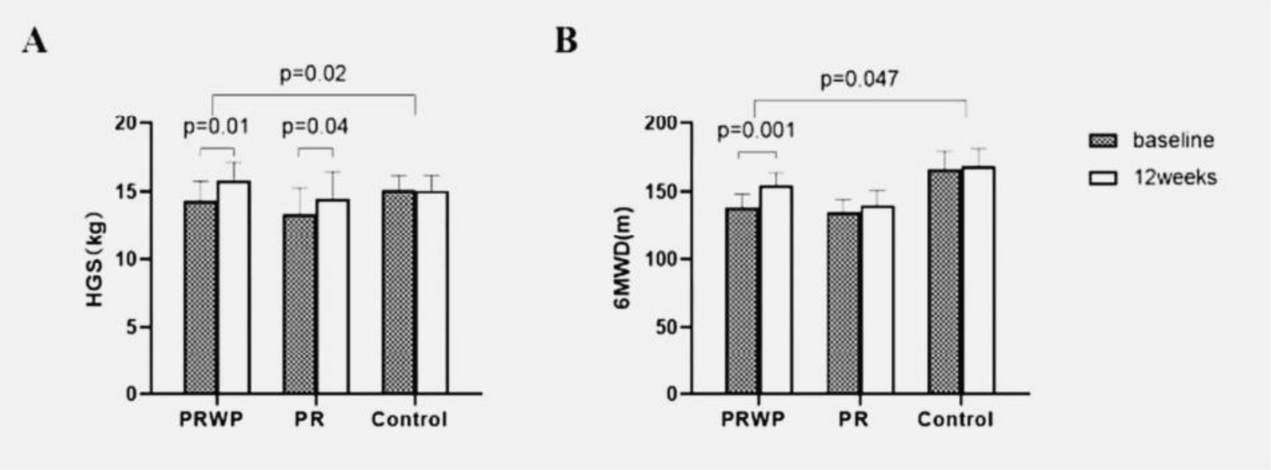


Table 2. Outcome of the intervention

Parameters	PRWP (n=27) Mean (SE)		
	Pre	Post	ΔPre-post
Muscle strength and endurance			
HGS, kg	14.3 (1.4)	15.8 (1.4)**	1.4 (0.5)
6MWD, m	139 (8.6)	155 (8.3)**	16.1 (3.6)
PI_{max}, $cmH_2O^{\dagger}$	33 (10)	34 (10)*	1 (4)
PE_{max}, $cmH_2O^{\dagger}$	40 (11)	43 (10)	2 (5)
Mental health status			
HADS-A	6.4 (0.5)	6.4 (0.4)	-0.04 (0.3)
HADS-D	12.2 (0.8)	11.8 (0.9)	-0.4 (0.7)
Lung function and symptom scores			
$\%FEV_1$, pred	71.7 (1.4)	71.9 (1.4)	0.3 (0.5)
MRC	2.1 (0.2)	1.8 (0.2)	-0.3 (0.1)*
CAT scores	17.0 (0.8)	16.4 (1.1)	-0.7 (0.7)
Body composition			
Weight, kg	57.9 (1.8)	59.2 (1.8)	1.2 (0.7)
BMI, kg/m^2	21.6 (0.7)	22.1 (0.6)	0.5 (0.3)
FMI, kg/m^2	7.4 (0.6)	8.3 (0.6)	0.9 (0.5)
FFMI, kg/m^2	14.2 (0.3)	13.7 (0.4)	-0.5 (0.4)
ASMI, kg/m^2	6.1 (0.3)	5.6 (0.2)	-0.1 (0.3)

Asia Pac J Clin Nutr 2023;32(4):375-382

Protein: Whey Protein

Effect of anti-inflammatory supplementation with whey peptide and exercise therapy in patients with COPD

Keiyu Sugawara [a], Hitomi Takahashi [a], Takeshi Kashiwagura [a], Kohko Yamada [b], Satoko Yanagida [b], Mitsunobu Homma [c], Kazuo Dairiki [d], Hajime Sasaki [d], Atsuyoshi Kawagoshi [e], Masahiro Satake [e], Takanobu Shioya [e,*]

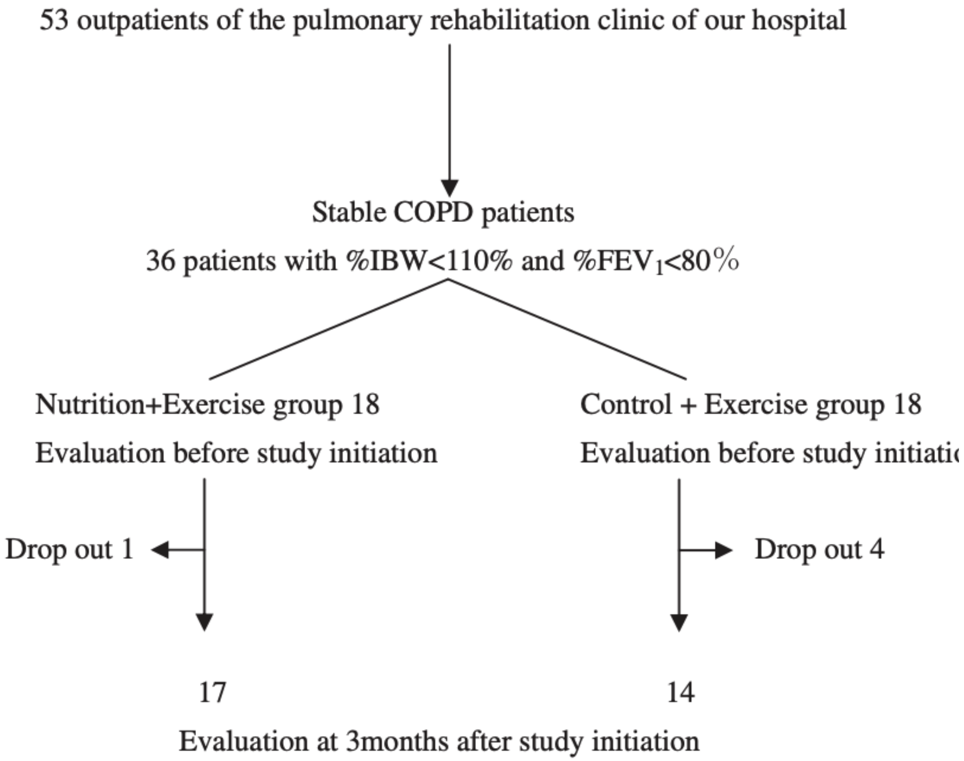


Table 4 Changes of body composition, muscle force, HRQOL and biomarkers.

	Nutrition + exercise group ($n = 17$)				Control group ($n = 14$)				Significant difference (between the group)
	Baseline	12 weeks	*P* value	Δratio, %	Baseline	12 weeks	*P* value	Δratio, %	*P* value
Weight, kg	50.8 ± 8.3	52.1 ± 8.3	0.002	2.6 ± 3.0	54.8 ± 4.3	54.6 ± 4.3	ns	-0.2 ± 1.4	0.0010
%IBW, %	89.2 ± 11.4	91.5 ± 11.8	0.0019	2.7 ± 3.0	94.1 ± 9.7	93.9 ± 9.3	ns	-0.2 ± 1.3	0.0017
FM, kg	12.7 ± 3.7	14.0 ± 4.0	0.0033	8.6 ± 10.7	13.8 ± 3.2	13.8 ± 2.8	ns	0.6 ± 10.6	0.0486
FFM, kg	38.0 ± 5.6	38.8 ± 5.4	ns	0.7 ± 2.6	40.9 ± 2.7	40.8 ± 2.2	ns	-0.1 ± 4.4	ns
FMI, kg/m^2	4.93 ± 1.36	5.43 ± 1.55	0.0028	8.6 ± 10.7	5.26 ± 1.43	5.23 ± 1.14	ns	0.6 ± 10.6	0.0486
FFMI, kg/m^2	14.7 ± 1.5	14.9 ± 1.3	ns	0.7 ± 2.6	15.4 ± 1.0	15.4 ± 1.1	ns	-0.1 ± 4.4	ns
Energy intake, kcal	1843 ± 291	2201 ± 229	<.0001	22.8 ± 16.9	2048 ± 319	2001 ± 333	ns	-1.0 ± 18.7	0.0013
Energy intake, %pred	84.6 ± 19.3	98.5 ± 16.8	0.0016	21.8 ± 23.0	92.4 ± 16.8	92.5 ± 25.1	ns	9.5 ± 23.8	ns
Protein intake, g	71.6 ± 13.6	91.7 ± 17.2	<.0001	31.6 ± 25.2	88.3 ± 20.3	78.0 ± 12.8	ns	-7.3 ± 28.7	0.0006
MRC	2.06 ± 0.75	1.87 ± 0.74	ns	-4.4 ± 17.2	2.00 ± 0.68	2.29 ± 0.61	ns	22.6 ± 40.6	0.0339
PImax, cmH_2O	44.4 ± 20.0	60.1 ± 22.1	0.0011	39.2 ± 38.9	67.1 ± 20.3	65.4 ± 20.5	ns	0.1 ± 24.1	0.0030
PEmax, cmH_2O	71.1 ± 32.9	91.4 ± 29.9	0.0107	40.1 ± 55.6	92.5 ± 29.4	97.0 ± 33.6	ns	8.8 ± 36.0	ns
6MWD,m	287 ± 206	368 ± 182	0.004	19.7 ± 24.7	369 ± 167	345 ± 187	ns	-7.1 ± 50.8	0.0137
WBI, kg/kg	0.51 ± 0.19	0.55 ± 0.18	0.0169	10.0 ± 13.3	0.72 ± 0.12	0.71 ± 0.15	ns	-1.6 ± 9.5	0.0079
CRQ (HRQOL)									
Total	103 ± 16	109 ± 17	0.0033	6.2 ± 7.5	102 ± 19	99 ± 21	ns	-2.7 ± 13.1	0.0374

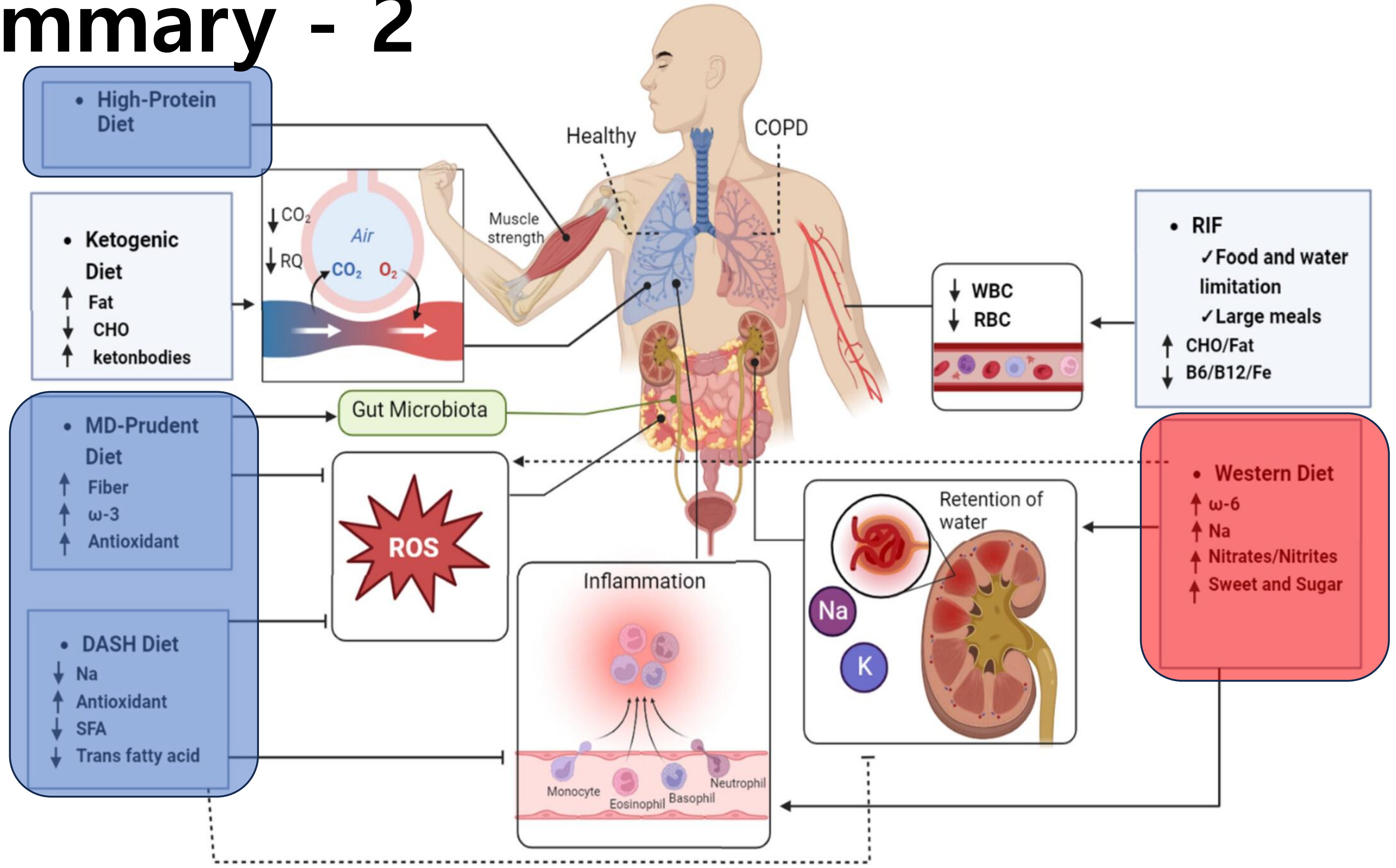
Respiratory Medicine (2012) 106, 1526-1534

Summary - 2

- Carbohydrates
    - FEV1 ↓, COPD prevalence ↑
        - Debate in High or Low carbo
        - Eat Good Carbo (non-free sugar, high fiber density, avoid free sugar)
- Fat: Good fat! Avoid bad fat.
- Protein: Whey protein, 1.2~1.5g/kg/day

→ Personalized Approach

Summary - 2



• High-Protein Diet
• Ketogenic Diet
↑ Fat
↓ CHO
↑ ketonbodies
↓ CO_2
↓ RQ
Air
CO_2 O_2
Muscle strength
Healthy
COPD
↓ WBC
↓ RBC
• RIF
✓Food and water limitation
✓Large meals
↑ CHO/Fat
↓ B6/B12/Fe
• MD-Prudent Diet
↑ Fiber
↑ ω-3
↑ Antioxidant
Gut Microbiota
ROS
• DASH Diet
↓ Na
↑ Antioxidant
↓ SFA
↓ Trans fatty acid
Inflammation
Monocyte
Eosinophil
Basophil
Neutrophil
Retention of water
Na
K
• Western Diet
↑ ω-6
↑ Na
↑ Nitrates/Nitrites
↑ Sweet and Sugar

Overview of Today's Talk

- Nutrition - Malnutrition
- Carbohydrate, Lipid, and Protein
- **Finding High Risk Patients and How to?**

In Nov 2021

10.임상연구계획서(CMC CD…

10.임상연구계획서(CMC CD… 52KB
수정일: 2021년 11월 15일 월요일 오후 6:03

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☐ 원판 파일
☐ 잠금

임상연구계획서

(익명화된 의무기록이용: CMC CDW 이용하는 경우)

1. 연구 과제명

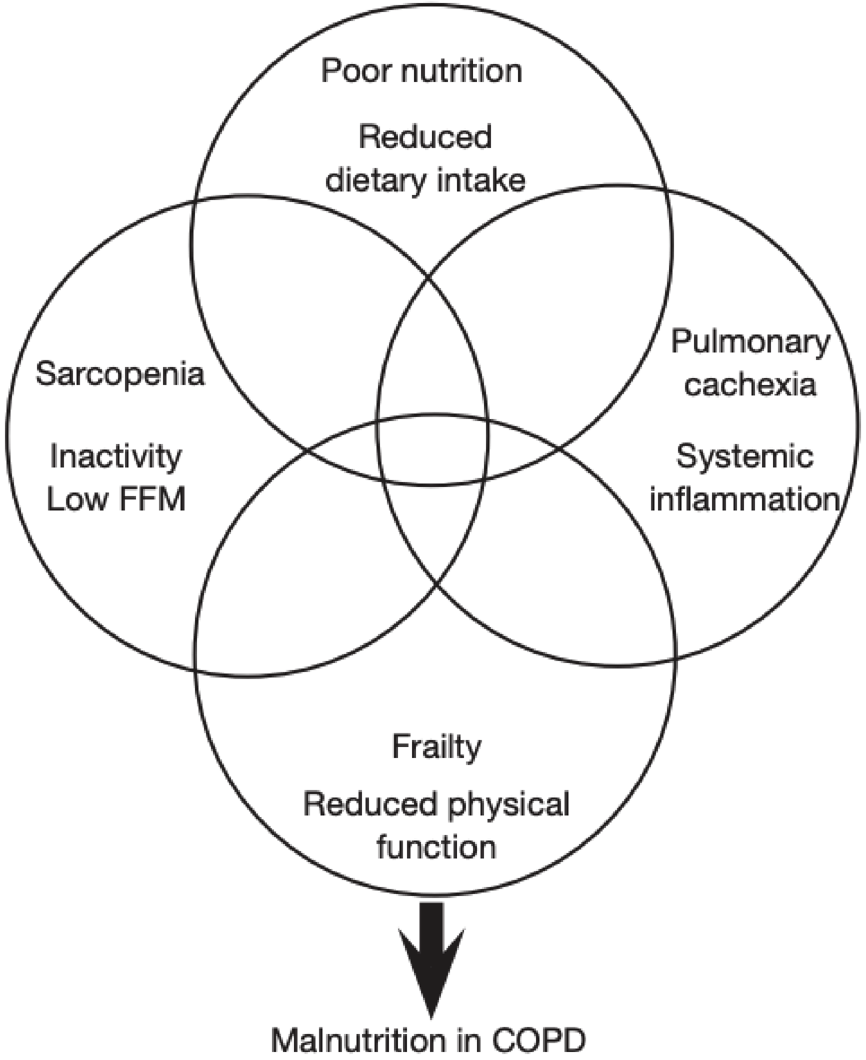
국문: 만성폐쇄성폐질환자의 영양상태에 따른 예후 분석
영문: **Evaluation of clinical prognosis according to nutritional status in COPD**

6. 연구 배경

만성폐쇄성폐질환(COPD)은 흔하며 전세계 사망원인 중 세번째로 많은 질환이다. COPD 환자는 건강한 사람에 비하여 많은 에너지가 호흡에 요구되는 반면, 영양섭취량이 상대적으로 적어 약 25-40%의 환자에서 영양부족상태가 확인된다. 영양부족 등으로 인한 저체중은 대표적인 만성폐쇄성폐질환 악화의 위험요소로 알려져 있다. 과거 국민건강영양평가를 활용한 연구에서 COPD 에서 영양섭취 부족이 많고, 영양 고위험군의 분류가 필요함이 드러났다.

일반적으로 타당성을 인정받은 영양평가도구로 가장 널리 사용되고 있는 지표는 NRS2002 이다. 하지만 COPD 에서의 NRS2002 의 임상적 유용성은 아직 밝혀진 바가 적다. 더욱이 국내 환자에게 그대로 적용하기 어려워 병원별로 개량되어 사용되고 있다. 가톨릭중앙의료원에서도 NRS2002 를 바탕으로 개량한 영양평가도구로 Catholic Medical Center Nutritional Risk Screening tool (CMCNRS)을 개발하여 사용하고 있다. 이 지표는 가톨릭중앙의료원 산하 7 개 병원에서 입원시 공통으로 적용하고 있는 지표이다. 본 연구자는 영양상태가 COPD 환자의 예후에 미치는 영향을 확인하고자, 이러한 지표를 활용하기 위한 도구로, Clinical Data Warehouse (이하 CDW)를 통하여 분석을 계획하였다.

Who Are at Risk?



- Nutritional score
  - NRS-2002
  - NUTRIC score
  - MNA
  - Etc.

Risk Score – MNA for elderly

Mini Nutritional Assessment
MNA®

Nestlé
NutritionInstitute

이름: ☐ 성별: ☐ 나이: ☐ 키: ☐ cm 체중: ☐ kg 일자: ☐

※ 해당 사항에 체크하시고, 오른쪽 빈 칸에 점수를 적으십시오.

Screening

A 지난 3개월 동안 밥맛이 없거나, 소화가 잘 안되거나, 씹고 삼키는 것이 어려워서 식사량이 줄었습니까?
0= 많이 줄었다
1= 조금 줄었다
2= 변화 없다 ☐

B 지난 3개월 동안 몸무게가 줄었습니까?
0= 3kg 이상 감소
1= 모르겠다
2= 1kg~3kg 감소
3= 변화 없다 ☐

C 거동 능력
0= 외출 불가, 침대나 의자에서만 생활 가능
1= 외출 불가, 집에서만 활동 가능
2= 외출 가능, 활동 제약 없음 ☐

D 지난 3개월 동안 정신적 스트레스를 경험했거나 급성 질환을 앓았던 적이 있습니까?
0= 예 2= 아니오 ☐

E 신경 정신과적 문제
0= 중증 치매나 우울증
1= 경증 치매
2= 없음 ☐

F1 체질량 지수 = kg 체중 / (m 높이)² ☐☐
0 = BMI < 19
1 = 19 ≤ BMI < 21
2= 21 ≤ BMI < 23
3= BMI ≥ 23 ☐

체질량지수를 모를 경우 F2 로 가십시오.
F1 응답을 하신 분은 F2 를 하실 필요가 없습니다.

F2 종아리둘레 (Calf circumference, cm)
0 = CC < 31
3 = CC ≥ 31 ☐

Screening score (총 14점)

☐☐

저장
인쇄
재설정

12-14 점 ☐ **정상**
8-11 점 ☐ **영양불량 위험 있음**
0-7 점 ☐ **영양불량**

Risk Score – MNA for elderly

Mini-Nutritional Assessment (MNA) is Useful for Assessing the Nutritional Status of Patients with Chronic Obstructive Pulmonary Disease: A Cross-sectional Study

	MNA-T1	MNA-T2
정의	대만 노인을 위해 표준 MNA를 **현지화**한 버전	MNA-T1에서 **BMI 항목을 삭제하고** 대신 **종아리 둘레(Calf Circumference, CC)** 항목을 넣은 버전
구성 항목	MNA의 원래 항목(18개)을 유지하되, 대만 고령자 기준으로 **신체 지표 cut-off 수정**	MNA-T1과 유사하지만, **BMI 대신 CC**를 사용 (BMI 측정 어려운 상황 고려)
사용 대상	비교적 건강한 고령자 또는 정확한 신장/체중 측정 가능한 경우	**BMI 측정이 어려운 환자** (예: 침상 생활, 중증 COPD 등)에게 적합
논문에서의 정확도	FFMI 예측: AUC = **0.804**	FFMI 예측: AUC = **0.813** → **약간 더 우수**

Measures - Indirect Calorimetry

- Calculation of heat production
- Measure O2 consumption and CO2 production
- Resting Energy Expenditure (REE)

  = [(VO2 x 3.94) + VCO2 x 1.11)]x1440 min/day

- Respiratory Quotient (RQ)

  = VCO2/VO2

How to? GOLD 2025

- 30~60% in admission, underweight in 90%
- COPD have significant systemic effects including weight loss, malnutrition.
- Low BMI, Low fat-free mass → worse outcome → Weight gain
- Anti oxidant supplement (Vit C, Vit E, Zinc, Selenium)
- Fatigue can be improved by nutritional support

How to? ESPEN

ESPEN Guideline

ESPEN-ESPGHAN-ECFS guideline on nutrition care for cystic fibrosis

Michael Wilschanski [a,*], Anne Munck [b], Estefania Carrion [c], Marco Cipolli [d], Sarah Collins [e], Carla Colombo [f], Dimitri Declercq [g], Elpis Hatziagorou [h], Jessie Hulst [c,i], Daina Kalnins [j], Christina N. Katsagoni [k,l], Jochen G. Mainz [m], Carmen Ribes-Koninckx [n], Chris Smith [o], Thomas Smith [p], Stephanie Van Biervliet [q], Michael Chourdakis [r]

- Screening tool + dietary review → every 6M
- Optimal nutritional target → higher
- Undernutrition → P. Aeruginosa risk
- Being obese → FEV1 improved
- Normal body composition → Longer survival
- EN or ONS, Soluble Vitamin, Vitamin D (cholecalciferol), Ca, Zinc, Fe (not in selenium)
- 식욕촉진제 (근거없음) 등등

Practical Nutrition Tips for Living with COPD - American Lung Association

Meal Tips

- Eat **5–6 small meals a day** instead of large ones
- Drink fluids **after meals** to avoid early fullness
- Focus on **high-calorie, high-protein, high-fiber** foods
- Choose **easy-to-prepare** foods: pre-cut fruits/veggies, precooked meats, frozen meals

What to Eat

- **Fiber**: Whole grains, vegetables, fruits, beans, nuts
- **Protein**: Meat, fish, eggs, dairy, nuts, tofu, protein shakes
- **Healthy fats**: Cheese, butter, olive oil, nut butters
- *Note: Full-fat dairy may increase mucus—listen to your body.*

간편 간식 예시 (Rachel 추천)
- 그릭 요거트 + 견과 + 베리
- 사과 + 땅콩버터 + 시나몬
- 삶은 달걀 + 치즈스틱 + 견과
- 스무디: 과일 + 요거트 + 견과버터

Latest ERS review

EUROPEAN RESPIRATORY REVIEW
SERIES
R.J.H.C.G. BEIJERS ET AL.

The role of diet and nutrition in the management of COPD

Rosanne J.H.C.G. Beijers[1], Michael C. Steiner[2] and Annemie M.W.J. Schols[1]

Number 6 in the Series "Non-pharmacological interventions in COPD: state of the art and future directions"
Edited by Geert M. Verleden and Wim Janssens

[1]Department of Respiratory Medicine, NUTRIM School of Nutrition and Translational Research in Metabolism, Maastricht University Medical Centre+, Maastricht, The Netherlands. [2]Leicester NIHR Biomedical Research Centre – Respiratory, Department of Respiratory Sciences, University of Leicester, Leicester, UK.

Corresponding author: Rosanne J.H.C.G. Beijers (r.beijers@maastrichtuniversity.nl)

Latest ERS review

Phenotype	Key Features	Clinical Risks	Interventions
Underweight / Cachexia			
Normal weight – Low Muscle			
Overweight / Obesity			
Sarcopenic Obesity			

Latest ERS review

- **Nutritional phenotype matters** more than weight alone
- Use **combined measures**: BMI + muscle (BIA, DEXA, CT) + function (HGS, Gait Speed)
- **Sarcopenic obesity** is common and under-recognized
- Tailored nutrition & exercise **can improve outcomes**
- Future research should define **long-term strategies** for phenotype-based care

How Much Protein?

- 안정기 권장 섭취량 (1.2~1.5 g/kg/day 이상)

Nutritional support in chronic obstructive pulmonary disease (COPD): an evidence update

Peter F. Collins[1], Ian A. Yang[2,3], Yuan-Chin Chang[2,3], Annalicia Vaughan[2,3]

J Thorac Dis 2019;11

Oral Nutritional Supplement

200ml → 10g

□원료약품의 분량

100mL(100kcal) 중
카제인(별규)···3.400g
(단백질 2.92g, 총 단백질 4.38g, 지방 0.03g, 인 24.684mg, 총 인 44.0mg)
분리대두단백질(별규)···1.666g
(단백질 1.46g, 지방 0.08g, 인 12.845mg)
트리카프릴린(별규)···0.750g
(지방 0.75g, 총 지방 2.23g)
대두유(JP)···0.699g
(리놀산 349.71mg, 총 리놀산 450mg, 리놀렌산 50.12mg, 지방 0.70g)
임자유(별규)···0.180g
(리놀산 25.60mg, 리놀렌산 94.59mg, 총 리놀렌산 150.0mg, 지방 0.18g)
팜유(별규)···0.334g
(리놀산 30.58mg, 지방 0.33g)

Summary - 3

- Finding High Risk – use MNA
- Measure REE – Indirect Calorimetry
- How to
  - 소량 자주, High Calories, low carbo, high fiber, high protein, good fat
  - Personalized Approach

우리에게 필요한 미래 방향

- 만성 호흡기질환에 최적화된 영양 평가 도구 개발
- 한국인에 맞는 적절한 영양 가이드라인 제안
- 외래 기반 NST 진료의 활성화 및 제도화

우리에게 필요한 미래 방향

- 간접열량측정법 (indirect calorimetry) – 수가 문제

I.행위-제2장 검사료 [제2021-58호 2021-02-25]

285 (간접열량 측정을 이용한 에너지 소모량 측정법의 급여기준)

나690주. 간접열량측정을 이용한 에너지 소모량 측정법은 기계환기 적용 중인 중환자실 입실 환자로, 자가 식이가 불가능하여 장내영양 또는 정맥영양을 받고 있는 경우에 요양급여를 인정하며, 환자 당 주1회 산정함 (고시 제2020-19호, '20.2.1. 시행)

복지부와 심평원은 이 같은 점을 인정하고 지난 2월 신의료기술을 건강보험 급여행위로 인정했다. 이에 따라 간접열량측정법에 매겨진 의료행위 수가는 약 3만원 수준이다.

하지만 문제는 간접열량측정법에 쓰이는 의료기기가 별도보상이 안 된다는 것.

소위 의료행위안에 치료재료 수가까지 포함된 탓인데, 현재 간접열량측정법에 쓰이는 의료기기 가격은 대당 1500만원에서 2000만원 수준이다.

또한 간접열량측정법 시 장비와 연결되는 1회용 구성품의 경우 개당 약 6만원에서 11만원으로 책정돼 있지만 이마저도 인정받지 못했다고 지적한다.

이 때문에 의료현장에서는 간접열량측정법이 급여 전환이 되기 전 인정 비급여일 때가 오히려 환자에게 낫다는 불만을 터트리고 있다. 의료행위 할 때마다 10만원 안팎의 비용이 소요되는데 의료수가는 3만570원으로 책정된 데에 따른 것이다.

우리에게 필요한 미래 방향

- **외래기반 NST**

구체적으로 환자 1명 당 주 1회, NST 당 일일 30명까지 인정되는 수가는 상급종합병원의 경우 4만3000원, 종합병원은 3만2000원 수준으로 형성돼 있다.

Google　NST 영양 평가 외래기반

전체　이미지　쇼핑　동영상　뉴스　짧은 동영상　웹　⋮ 더보기

AI 개요

영양집중치료팀(NST)은 외래환자의 영양상태를 평가하고 영양지원을 제공할 수 있습니다.

NST의 역할

- 영양불량 환자, 중환자, 수술을 앞둔 환자의 영양상태를 평가합니다
- 영양필요량을 산정합니다
- 영양치료 계획을 수립합니다
- 영양관리 및 영양교육을 시행합니다
- 장관 및 정맥 영양을 제공받는 환자에게 영양집중지원관리를 시행합니다

NST의 활동 현황

- 미국에서는 1970년대부터 NST가 활동을 시작했습니다
- 우리나라는 2009년부터 상급종합병원과 종합병원을 대상으로 NST 인증 평가제를 시행하고 있습니다
- 일선 대학병원 중심으로 NST가 이뤄지고 있습니다

NST의 활동을 위한 개선사항

- 병원 내 NST의 수가를 현실화해야 합니다
- 영양지원 근거 기반 진료지침을 제정해야 합니다
- 가정에서 올바른 투여와 모니터링을 위한 가정간호 체계를 확립해야 합니다

“Its now or never”

Thank you for your attention.