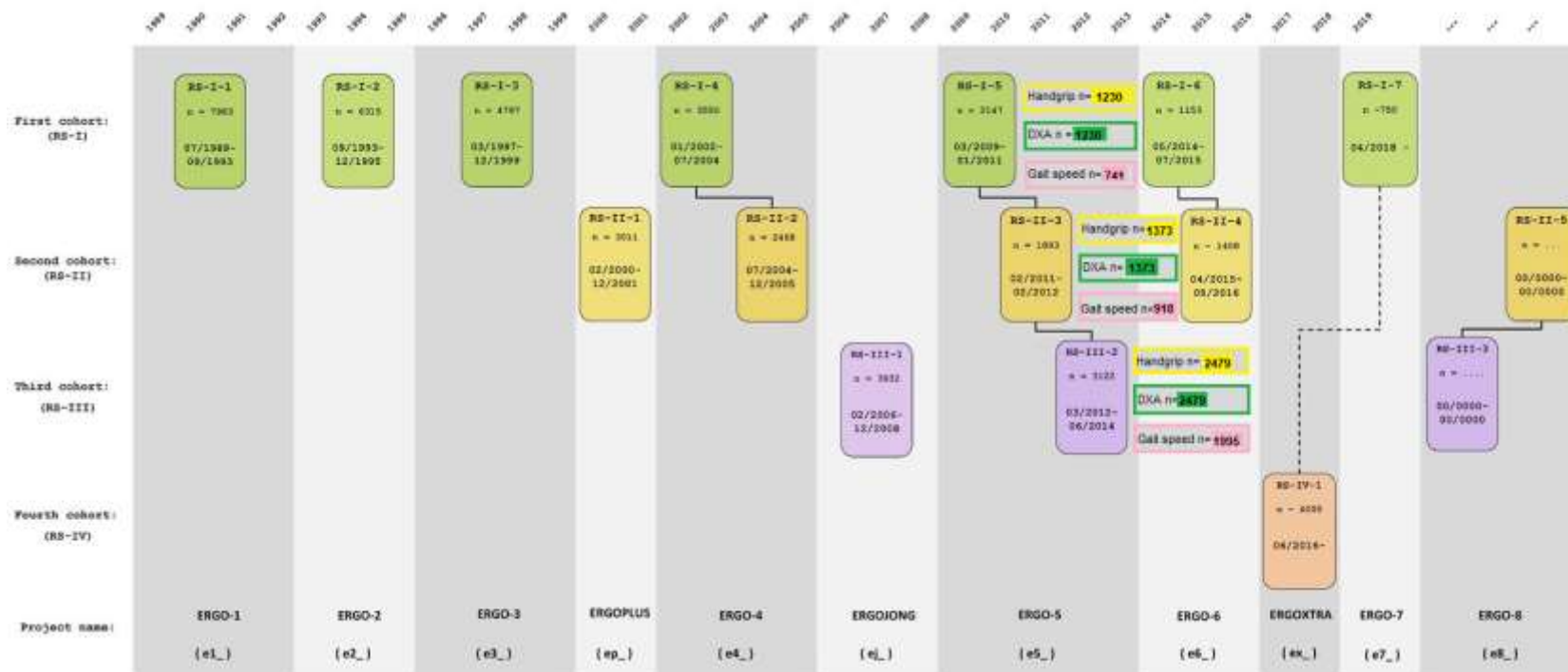


Supplementary material

Sarcopenia in older people with chronic airway diseases: the Rotterdam study.

Elizabeth Benz, Katerina Trajanoska, Josje D Schoufour, Lies Lahousse, Emmely W. de Roos, Natalie Terzikhan, Carolina Medina-Gomez, Katia Verhamme, Ross Williams, Bruno H. Stricker, Oscar H Franco, M. Arfan Ikram, Fernando Rivadeneira, Guy Brusselle.



Supplementary figure 1. Diagram of the cycles of the Rotterdam Study (RS) (1). RS I-I refers to the baseline examination of the original cohort (pilot phase 07/1989-12/1989; cohort recruitment 01/1990-09/1993). R I-2, RS I-3, RS I-4, RS I-5, RS I-6 and RS I-7 refer to re-examinations of the first cohort. RS II-1 refers to the extension of the cohort. RS II-2, RS II-3, RS II-4 and RS II-5 refers to re-examinations of the extension of this second cohort. RS III-1 refers to the baseline examination of all participants older than 45 years old. RS III-2 and RS III-3 refers to the re-examinations of this third cohort. RS IV-1 refers to the baseline visit of a new cohort, established in summer 2016. For this cross-sectional analysis we included participants from RS I-5 (n=1230), RS II-3 (n=1373) and RS III-2 (n=2479) (ERGO-5 n=5082).

Supplementary table 1. Main characteristics of the study population according to sarcopenia status and chronic airway diseases (n=5082).

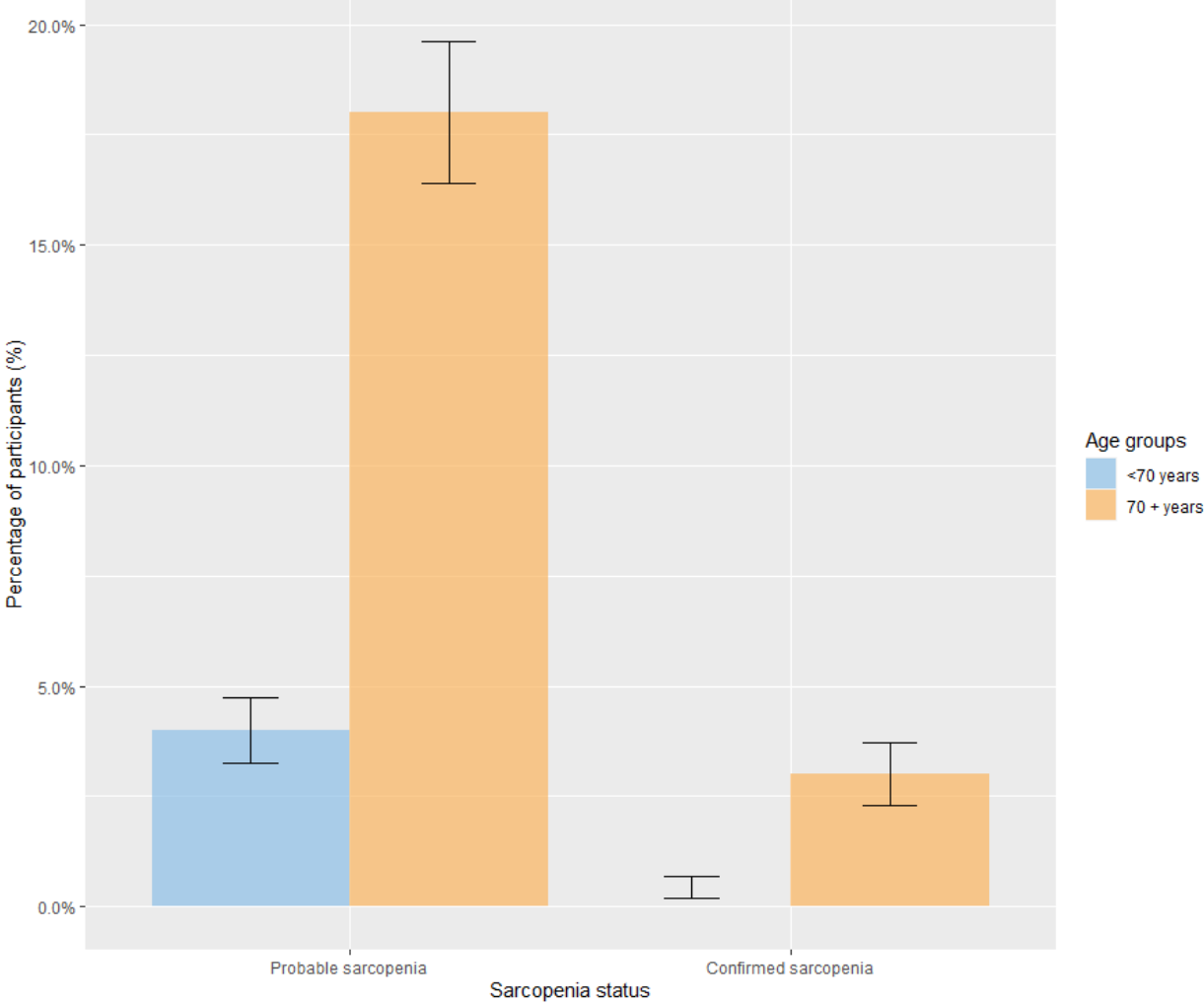
	No sarcopenia (n=4494)		Probable sarcopenia (n=506)		Confirmed sarcopenia (n=82)	
	Chronic airway diseases		Chronic airway diseases		Chronic airway diseases	
	Yes n=1060	No n=3434	Yes n=150	No n=356	Yes n=36	No n=46
Participants n						
Age years	68.7±8.6	67.6±8.2	77.5±8.3	76.9±8.3	78.3±8.1	78.4±9.5
Age groups						
<70 years	604 (57.0)	2155 (62.8)	30 (20.0)	71 (19.9)	5 (13.9)	8 (15.7)
≥70 years	456 (43.0)	1279 (37.2)	120 (80.0)	285 (80.1)	31 (86.1)	38 (82.6)
Sex						
Female	550 (51.9)	1968 (57.3)	87 (58.0)	225 (63.2)	10 (27.8)	23 (50.0)
Male	510 (48.1)	1466 (42.7)	63 (42.0)	131 (36.8)	26 (72.2)	23 (50.0)
BMI kg/m²	27.3±4.5	27.6±4.6	28.1±3.7	27.9±4.1	22.8±2.5	22.7±2.6
BMI status						
Overweight	468 (44.2)	1712 (49.9)	74 (48.3)	178 (50.0)	7 (19.4)	7 (15.2)
Obese	246 (23.2)	786 (22.9)	40 (27.7)	53 (29.1)	-	-
Smoking						
Never	228 (21.5)	1283 (37.4)	45 (30.0)	137 (38.5)	8 (22.2)	16 (34.8)
Past	601 (56.7)	1812 (52.8)	86 (57.3)	204 (57.3)	21 (58.3)	25 (54.3)
Current	231 (21.8)	339 (9.9)	19 (12.7)	15 (4.2)	7 (19.4)	5 (10.9)
Lung function						
FEV1/FVC (%)	67.6±8.8	78.8± 4.5	68.1±8.8	78.8±5.1	62.2±10.8	77.8±5.8
FEV1 predicted (%)	83.2±19.2	103.9±13.8	80.3±17.1	101.5±14.6	71.5±19.9	100.1±15.1
FVC predicted (%)	94.1±16.8	101.8±13.1	89.1±13.6	98.4±14.4	85.5±13.9	97.6±13.8
Total body fat (%)						
Female	39.8±6.6	40.1±6.0	41.5±5.6	40.7±5.9	35.1±7.3	35.7±4.8
Male	31.1±6.1	30.8±5.3	33.1±5.6	32.3±5.0	29.9±5.6	31.3±6.9
Components sarcopenia						
HGS (kg)						
Female	23.1±4.9	23.6±4.7	12.6±2.8	12.6±2.3	11.8±2.3	12.3±2.9
Male	38.6±7.6	38.9±7.4	22.9±3.1	22.6±3.5	21.1±4.6	21.9±4.5
ASMI (kg/m²)						
Female	6.9±0.9	6.9±0.8	6.7±0.9	6.7±0.8	5.1±0.4	5.1±0.3
Male	8.1±0.9	8.5±0.9	7.9±0.6	8.2±0.7	6.4±0.7	6.4±0.5
# Walking speed (m/s)	1.2 (1.1-1.3)	1.2 (1.1-1.4)	1.0 (0.9-1.2)	1.1 (0.9-1.2)	1.0 (0.8-1.1)	1.0 (0.8-1.2)
# PA (METhours/week)	38.1 (15.4-74.6)	47.9 (18.7-84.9)	23.5 (11.0-65.2)	27.8 (11.2-63.0)	22.5 (13.5-43.7)	22.3 (8.6-54.6)
# % protein intake	15.7±3.0	15.7±2.8	15.9±3.4	15.7±3.2	14.6±2.6	14.7±2.4
OCS, n (%)						
Never	548 (52.0)	2498 (73.0)	56 (37.0)	218 (61.0)	11 (31.0)	33 (72.0)
Past	462 (44.0)	893 (26.0)	82 (55.0)	125 (35.0)	19 (53.0)	11(24.0)
Current	50 (5.0)	43 (1.0)	12 (8.0)	13 (4.0)	6 (17.0)	2 (4.0)
Co-morbidities, n (%)						
Diabetes mellitus	173 (17.0)	413 (12.2)	27 (19.0)	67 (20.0)	10 (28.0)	9 (20.0)
Hypertension	778 (73.0)	2373 (69.1)	131 (87.0)	309 (87.0)	32 (89.0)	33 (73.3)
Cancer	108(10.0)	329 (9.6)	21 (14.0)	55 (15.4)	6 (17.0)	5 (10.9)
CHD	120 (11.0)	245 (7.1)	21 (14.0)	35 (9.8)	7 (19.0)	6 (13.0)

Continuous variables are presented as means ± standard deviation (SD), or median values with corresponding interquartile ranges (IQR). Categorical variables are presented as frequency (%).

Abbreviations: BMI= body mass index; Overweight: BMI= >25 and < 30 kg/m²; Obese: BMI=≥30 kg/m². FEV1/FVC=forced expiratory volume in one second to forced vital capacity ratio; FEV1 predicted (%)= predicted forced expiratory volume in one second; FVC predicted (%)=predicted forced vital capacity; HGS= handgrip strength; ASMI= appendicular skeletal muscle mass index; PA=physical activity; OCS=oral corticosteroids use; MET=metabolic equivalent of task; CHD= coronary heart diseases.

[#]Number (%) of missing values per variable: walking speed= 1428 (28.1%), physical activity= 601 (11.8%), % protein intake= 1,041 (20.5%), Diabetes Mellitus = 92 (1.8%), Hypertension=1 (0.0%), Chronic pain= 5 (0.1), CHD= 53 (1.0%). Original data without imputations.

Supplementary figure 2. Prevalence of sarcopenia (probable and confirmed) according to age groups in participants with and without chronic airway diseases.



Supplementary table 2. Sarcopenia status according to the number of comorbidities in participants with and without chronic airway diseases.

	No chronic airway diseases (n=3836)		
	No sarcopenia (n=3434)	Probable sarcopenia (n=356)	Confirmed sarcopenia (n=46)
No comorbidity (n=440)	12.2% (n=418)	4.2% (n=15)	15.2% (n=7)
One comorbidities (n=1542)	41.4% (n=1423)	29.8% (n=106)	28.3% (n=13)
Two comorbidities (n=1306)	33.2% (n=1141)	42.1% (n=150)	32.6% (n=15)
At least three comorbidities (n=548)	13.2% (n=452)	23.9% (n=85)	23.9% (n=11)

	Chronic airway diseases (n=1246)		
	No sarcopenia (n=1060)	Probable sarcopenia (n=150)	Confirmed sarcopenia (n=36)
No comorbidity (n=126)	11.3% (n=120)	4.0% (n=6)	0% (n=0)
One comorbidities (n=394)	32.5% (n=344)	28.0% (n=42)	22.2% (n=8)
Two comorbidities (n=474)	37.3% (n=395)	40.7% (n=61)	50.0% (n=18)
At least three comorbidities (n=252)	19.0% (n=201)	27.3% (n=41)	27.8% (n=10)

Comorbidities: type 2 diabetes mellitus, hypertension, cancer, coronary heart diseases.

Supplementary table 3. Components and combination of the three components of sarcopenia: handgrip, lean mass and walking speed (complete cases of three components, n=3654).

Outcome	Definition	Total population	No chronic airway diseases (n=2818)	Chronic airway diseases n=836
Normal handgrip normal lean mass normal walking speed	Normal	3114 (85.2%)	2249 (86.9%)	665 (79.5%)
Low handgrip only	Probable sarcopenia	253 (6.9%)	181 (6.4%)	72 (8.6%)
Low lean mass only	Malnutrition*	132 (3.6%)	74 (2.6%)	58 (6.9%)
Low walking speed only	"undefined"	60 (1.6%)	48 (1.7%)	12 (1.4%)
Low handgrip and low lean mass	Confirmed sarcopenia	39 (1.1%)	25 (0.9%)	14 (1.7%)
Low handgrip and low walking speed	"undefined"	39 (1.1%)	31 (1.1%)	8 (1.0%)
Low lean mass and low walking speed	"undefined"	7 (0.2%)	5 (0.2%)	2 (0.2%)
Low handgrip plus low lean mass plus low walking speed	Severe sarcopenia	10 (0.3%)	5 (0.2%)	5 (0.6%)

*According to the new recommendations of the Global Leadership Initiative on Malnutrition (2), having low muscle mass with normal muscle strength would be considered as *malnutrition* rather than *sarcopenia*.

Supplementary table 4. Prevalence of sarcopenia (probable and confirmed) according to individual chronic airway diseases.

Total n=5082	No chronic airway diseases n=3836	COPD n=779	Asthma n=439	ACO n=28
No sarcopenia n=4494	76.4% (3,434)	14.8% (664)	8.3% (372)	0.5% (24)
Probable sarcopenia n=506	70.4% (356)	17.6% (89)	11.3% (57)	0.8% (4)
Confirmed sarcopenia n=82	56.1% (46)	31.7% (26)	12.2% (10)	0% (0)

Abbreviations. ACO: asthma COPD overlap, COPD: chronic airway disease

Supplementary table 5. Sarcopenia components and sarcopenia status according to sex and chronic airway diseases.

Total (n=5082)	Male (n=2219)		Female (n=2863)	
	No chronic airway diseases	Chronic airway diseases	No chronic airway diseases	Chronic airway diseases
Sarcopenia components				
Low handgrip strenght	154 (9.5%)	89 (14.9%)*	248 (11.2%)	97 (15.0%)
Low ASMI	91 (5.6%)	82 (13.7%)*	68 (3.1%)	46 (7.1%)*
Low walking speed#	21 (1.7%)	13 (3.1%)	68 (4.3%)	14 (3.3%)
Sarcopenia status				
No sarcopenia	1466 (90.5%)	510 (85.1%)	1968 (88.8%)	550 (85.0%)
Probable sarcopenia	131 (8.1%)	63 (10.5%)	225 (10.2%)	87 (13.4%)
Confirmed sarcopenia	23 (1.4%)	26 (4.3%)*	23 (1.0%)	10 (1.5%)

Abbreviations: ASMI=appendicular skeletal mass index.

Differences to normal handgrip strength (low <27kg in male, <16 kg in female) and normal ASMI (low <7.0 kg/m² in male, <5.5 kg/m² in female), adjusted for age in logistic regression (p-value<0.05).

Difference to no sarcopenia group adjusted for age in multinomial logistic regression (p-value<0.05)

#missing values: male 549 (24.7%), female 879 (30.7%).

Table 6. Association between FEV₁ ($\geq 80\%$ and $< 80\%$) and sarcopenia status in participants with chronic airway diseases (n=1246).

Sarcopenia status	FEV ₁ (%pred)	Model 1	Model 2
Probable sarcopenia (n=150)	$\geq 80\%$ (n=80)	OR (95% CI) Ref.	OR (95% CI) Ref.
	$< 80\%$ (n=70)	1.06 (0.74; 1.53)	1.06 (0.72; 1.55)
Confirmed sarcopenia (n=36)	$\geq 80\%$ (n=14)	Ref.	Ref.
	$< 80\%$ (n=22)	1.78 (0.88; 3.58)	1.82 (0.88; 3.78)

Notes: CI=confidence interval; OR=odd ratio.

Model 1: adjusted for age and sex.

Model 2: model 1 plus total body fat (%), height (cm) and smoking status.

Supplementary table 7. Sarcopenia status prevalence in participants without comorbidities

Only participants with **no comorbidity**

Total n=566	No chronic airway diseases n=440	Chronic airway diseases n=126
No sarcopenia (n=538)	95.0% [95% CI 92.9-97.0] n=418	95.0% [95% CI 91.1-98.8] n=120
Probable sarcopenia (n=21)	3.4% [95% CI 1.7-5.1] n=15	4.8% [95% CI 1.1-8.5] n=6
Confirmed sarcopenia (n=7)	1.6%[95% CI 0.6-3.3] n=7	No cases

All participants included

Total n=5082	No chronic airway diseases n=3836	Chronic airway diseases n=1246
No sarcopenia (n=4494)	89.5% [95% CI 88.5-90.5] n=3434	85.1% [95% CI 82.0-86.1] n=1060
Probable sarcopenia (n=506)	9.3%[95%CI 8.4-10.2] n=356	12.4% [95% CI 10.5-14.2] n=150
Confirmed sarcopenia (n=97)	1.2% [95% CI 0.8-1.5] n=46	3.0 %[95% CI 2.1-3.9] n=36

Supplementary table 8. Association between chronic airway diseases and individual components of sarcopenia (HGS and ASMI) in participants without comorbidities (n=566)

Individual Components of sarcopenia	Chronic airway diseases	Model 1		Model 2	
		β (SE)	(95% CI)	β (SE)	95% CI
*HGS (kg)		β (SE)	(95% CI)	β (SE)	95% CI
	No (n=440)	Ref.		Ref.	
	Yes (n=126)	-0.70 (0.65)	-0.57; 1.98	0.41 (0.64)	-0.84; 1.67
ASMI (kg/m ²)		β (SE)	(95% CI)	β (SE)	95% CI
	No (n=440)	Ref.		Ref.	
	Yes (n=126)	-0.24 (0.08)	-0.40; -0.08	-0.21 (0.08)	-0.37; -0.05

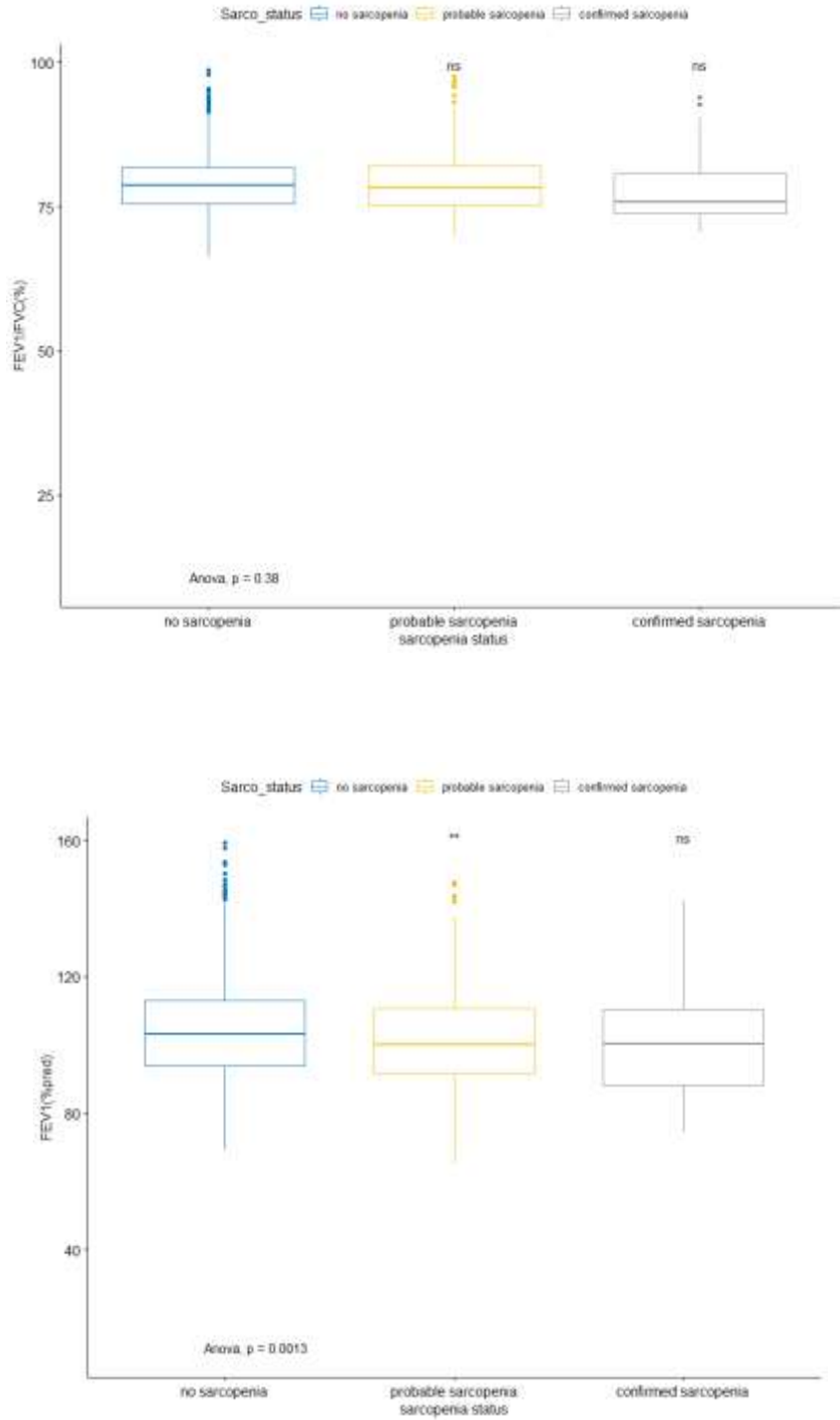
Notes: CI=confidence interval; Reference group= no-chronic airway diseases; ASMI= appendicular skeletal muscle mass index. HGS=handgrip strength.

Model 1: adjusted for age and sex

Model 2: model 1 plus total body fat (%), height* (cm) and smoking status

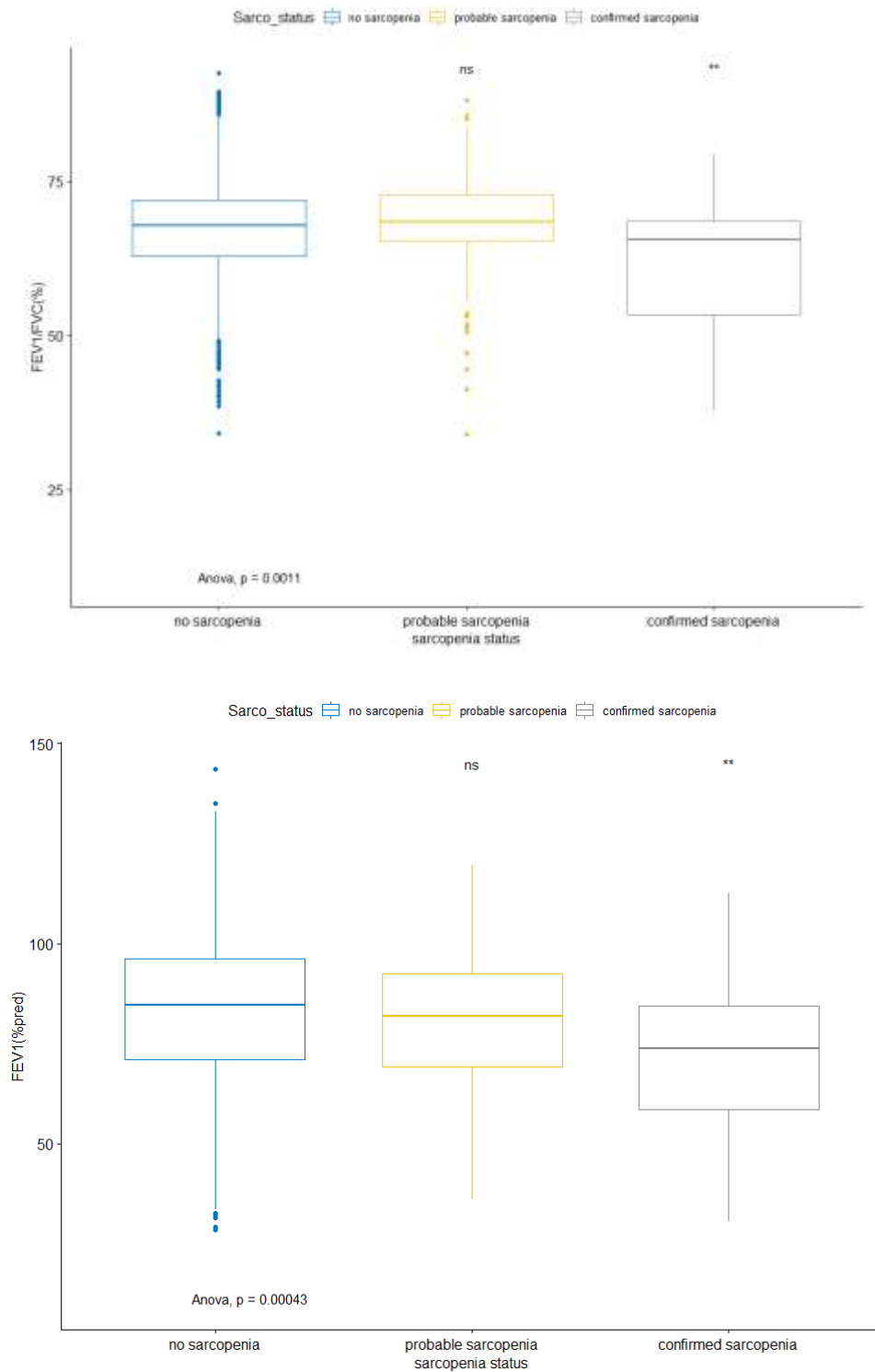
*Height is only included in the HGS model due to ASMI is already calculated based on height (m²).

Supplementary figure 3a. Comparison of lung function (FEV₁/FVC (%) and FEV₁ (% pred)) according to the presence of sarcopenia in participants without chronic airway diseases n=3836 (mean, 95% CI).



Mean lung function parameters (FEV₁/FVC and FEV₁) compared to no sarcopenia group tested by ANOVA (p-value<0.05).

Supplementary figure 3b. Comparison of lung function (FEV₁/FVC (%) and FEV₁ (% pred)) according to the presence of sarcopenia in participants with chronic airway diseases n=1246 (mean, 95% CI).



Mean lung function parameters (FEV₁/FVC and FEV₁) compared to no sarcopenia group tested by ANOVA (p-value<0.05).

Supplementary table 9a. Association between individual components of sarcopenia (HGS and ASMI) and lung function (FEV1/FVC,%) in no chronic airway diseases (n=3836).

Individual components of sarcopenia	FEV ₁ /FVC				FEV ₁ %			
	Model 1		Model 2		Model 1		Model 2	
	β (95% CI)	p-value	β (95% CI)	p-value	β (95%CI)	p-value	β (95%CI)	p-value
	Ref.				Ref.			
*HGS (kg)	-0.06 (-0.09;-0.01)	0.009	-0.04 (-0.09; -0.00)	0.039	0.05 (0.03; 0.06)	<0.001	0.05 (0.03; 0.06)	<0.001
ASMI (kg/m ²)	0.02 (0.01; 0.02)	<0.001	0.01 (0.01; 0.02)	<0.001	-0.00 (-0.00; 0.00)	0.855	0.00 (0.00; 0.01)	<0.001

Notes: CI=confidence interval; ASMI= appendicular skeletal muscle mass index. HGS=handgrip strength.

Model 1: adjusted for age and sex

Model 2: model 1 plus total body fat (%)and height and smoking status

Supplementary table 9b. Association between individual components of sarcopenia (HGS and ASMI) and lung function (FEV1/FVC,%) in chronic airway diseases (n=1,246).

Individual components of sarcopenia	FEV ₁ /FVC				FEV ₁ %			
	Model 1		Model 2		Model 1		Model 2	
	β (95% CI)	p-value	β (95% CI)	p-value	β (95%CI)	p-value	β (95%CI)	p-value
	Ref.				Ref.			
*HGS (kg)	0.01 (-0.03; 0.05)	0.593	0.03 (-0.01; 0.07)	0.138	0.04 (0.02; 0.06)	<0.001	0.04 (0.04;0.06)	<0.001
ASMI (kg/m ²)	0.03 (0.02; 0.03)	<0.001	0.02 (0.01; 0.03)	<0.001	0.01 (0.00; 0.01)	<0.001	0.01 (0.00; 0.01)	<0.001

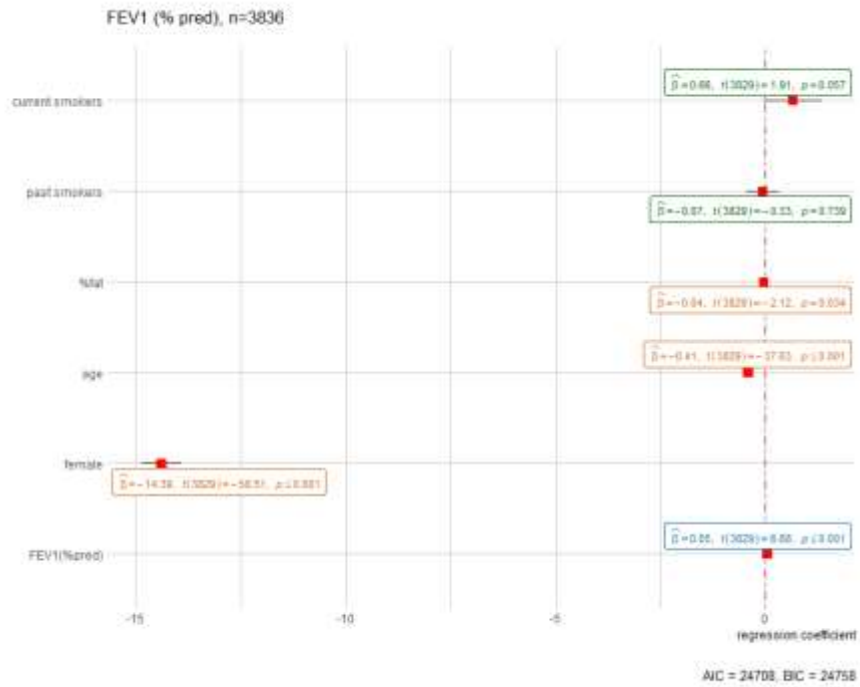
Notes: CI=confidence interval; ASMI= appendicular skeletal muscle mass index. HGS=handgrip strength.

Model 1: adjusted for age and sex

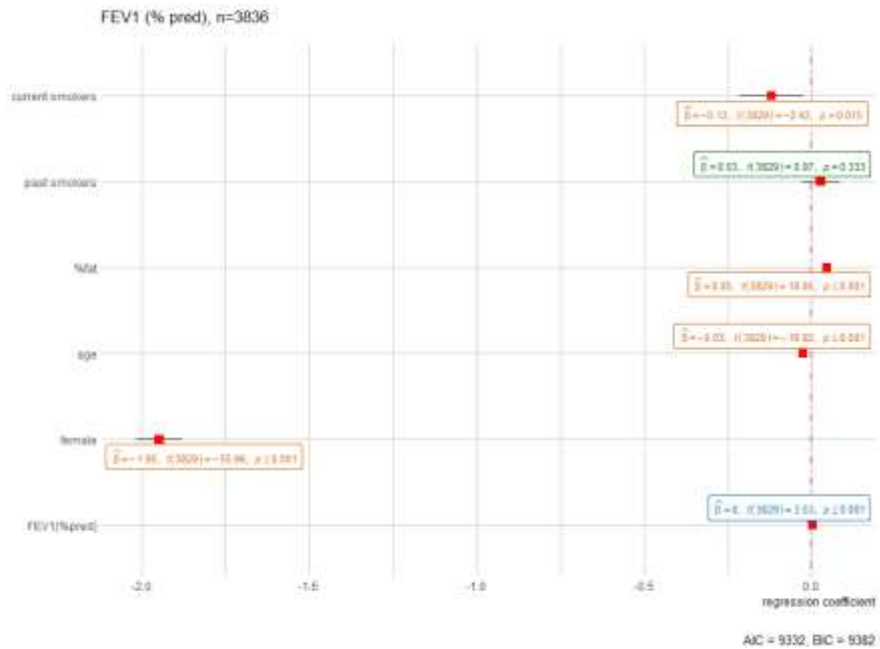
Model 2: model 1 plus total body fat (%)and height* and smoking status

Figure 4a. Association between individual components of sarcopenia (1. HGS and 2. ASMI) and lung function (FEV1 (% pred)) in participants without chronic airway diseases (n=3836).

1. Handgrip*



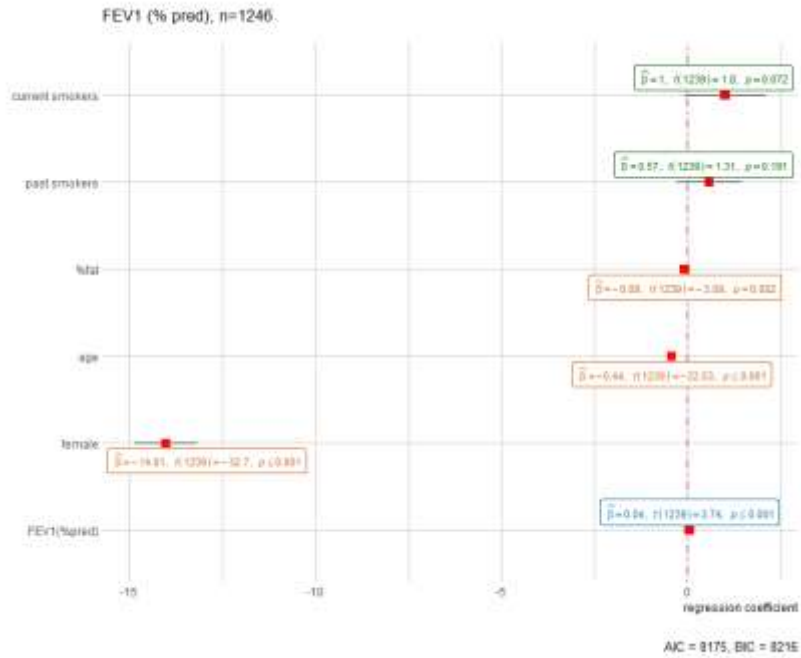
2. Appendicular skeletal mass index



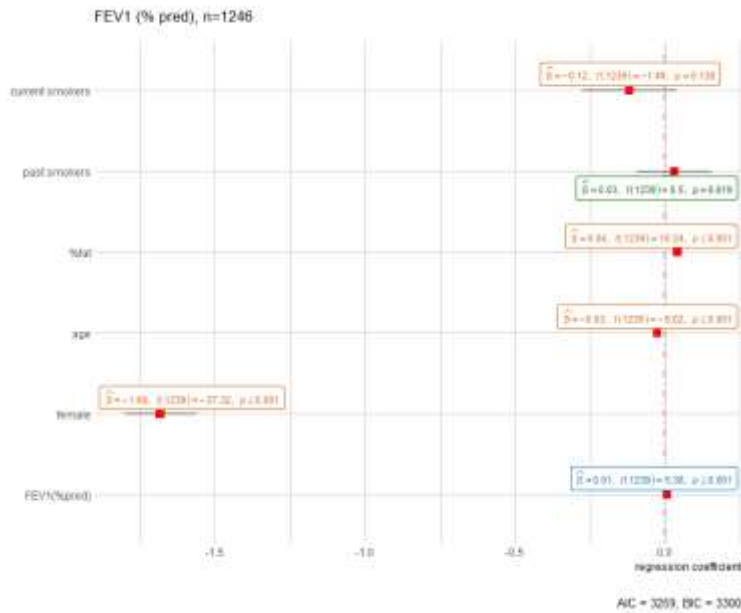
Multiple linear regression model adjusted for age, sex, height*, total body fat (%) and smoking status.

Figure 4b. Association between individual components of sarcopenia (1. HGS and 2. ASMI) and lung function (FEV1 (% pred)) in participants with chronic airway diseases (n=1246).

1. Handgrip*



2. Appendicular skeletal mass index



Multiple linear regression models adjusted for age, sex, height*, total body fat (%) and smoking status.

Supplementary table 10. SARC-F sarcopenia questionnaire (0-10 points) (3)

Component	Question	Score
Strength	How much difficulty do you have in lifting and carrying 10 pounds?	None=0 Some=1 A lot or unable=2
Assistance in walking	How much difficulty do you have walking across a room?	None=0 Some=1 A lot, use aids, or unable=2
Rise from a chair	How much difficulty do you have transferring from a chair or bed?	None=0 Some=1 A lot or unable without help=2
Climb stairs	How much difficulty do you have climbing a flight of 10 stairs?	None=0 Some=1 A lot or unable=2
Falls	How many times have you fallen in the last year?	None=0 1-3 falls=1 4 or more falls=2

Abbreviation: SARC-F: S=strength, A=assistance with walking, R=rise from a chair, C=climbs stairs, F=falls.

Reference in Supplementary material

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