
ANHI
ABBOTT NUTRITION HEALTH INSTITUTE
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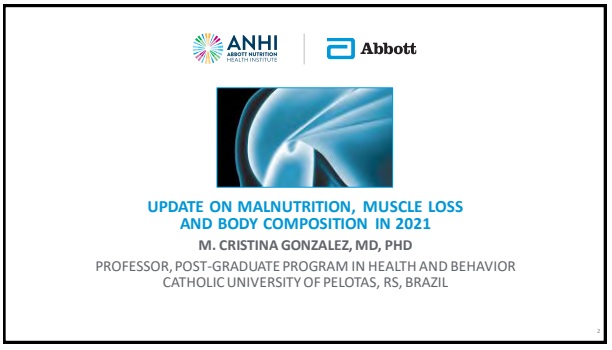
119TH ABBOTT NUTRITION RESEARCH CONFERENCE (ANRC)
MALNUTRITION, MUSCLE AND BODY COMPOSITION:
LATEST ADVANCES AND INNOVATION FOR THE FUTURE
SLIDE HANDOUTS
Tuesday, June 22, 2021
8:00 AM – 11:00 AM ET

1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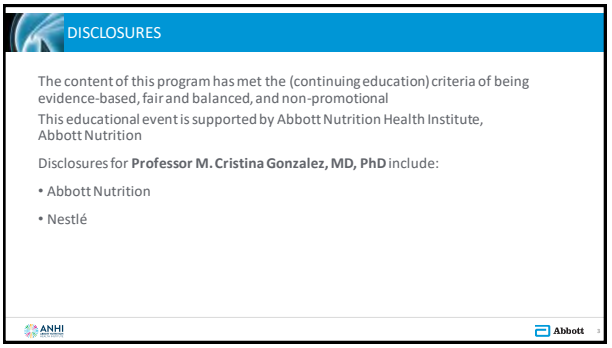
UPDATE ON MALNUTRITION, MUSCLE LOSS
AND BODY COMPOSITION IN 2021
M. CRISTINA GONZALEZ, MD, PHD
PROFESSOR, POST-GRADUATE PROGRAM IN HEALTH AND BEHAVIOR
CATHOLIC UNIVERSITY OF PELOTAS, RS, BRAZIL

2


DISCLOSURES
The content of this program has met the (continuing education) criteria of being evidence-based, fair and balanced, and non-promotional
This educational event is supported by Abbott Nutrition Health Institute, Abbott Nutrition
Disclosures for Professor M. Cristina Gonzalez, MD, PhD include:
• Abbott Nutrition
• Nestlé
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3

OBJECTIVES

1. Review key concepts related to malnutrition and muscle assessment
2. Discuss the clinical implications of associated malnutrition and low muscle mass
3. Examine recent advances in body composition assessment and their use in research and clinical practice

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4

MALNUTRITION

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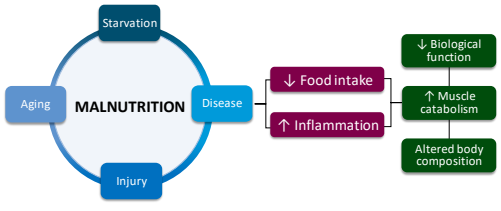
5

MALNUTRITION IS CAUSED BY REDUCED FOOD INTAKE & INFLAMMATION



Cederholm T, et al. *Clin Nutr.* 2019;38(1):1-9.
Jensen GL, et al. *J Parenter Enteral Nutr.* 2019;43(1):32-40.
Druml W, et al. *JAMDA.* 2016;17(11):975-980.

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6

MALNUTRITION IS ASSOCIATED WITH ADVERSE HEALTH OUTCOMES

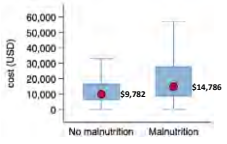
Abugroun A, et al. *Am J Med*. 2021;134(2):221-26; Lanctin DP, et al. *Acad Emerg Med*. 2021;28(3):325-35; McLaughlin J, et al. *J Nutr Health*. 2020;26(3):175-78; Yu W, et al. *Psychogeriatr*. 2021;21(1):80-8; Han TS, et al. *Eur J Clin Nutr*. 2021;75(4):646-52; Huang DD, et al. *Clinical Nutr*. Forthcoming 2021.

7

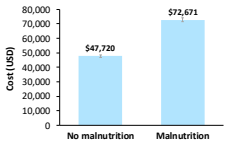
OVERALL COSTS ARE GREATER IN PATIENTS WITH MALNUTRITION

Malnutrition → International Classification of Diseases (ICD-9 and ICD-10)

OLDER ADULTS ADMITTED WITH A DIAGNOSIS OF SEPSIS



PATIENTS PRESENTING TO U.S. EMERGENCY DEPARTMENTS



Abugroun A, et al. *Am J Med*. 2021;134(2):221-226.e1.
Lanctin DP, et al. *Acad Emerg Med*. 2021;28(3):325-335.

8

MALNUTRITION TREATMENT REDUCES MORTALITY RATE

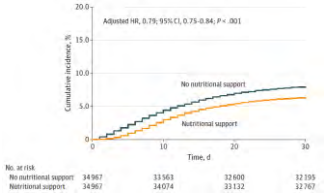
Malnutrition → International Classification of Diseases (ICD-10)

69,934 HOSPITALIZED PATIENTS WITH MALNUTRITION

Patients with malnutrition receiving vs. NOT receiving nutritional support

- ↓ In-hospital mortality rate
- ↓ 30-day readmission rate
- ↓ Discharge to a post-acute care facility

Figure 2. Kaplan-Meier Curve for Propensity Score-Matched Rate of All-Cause In-Hospital Mortality

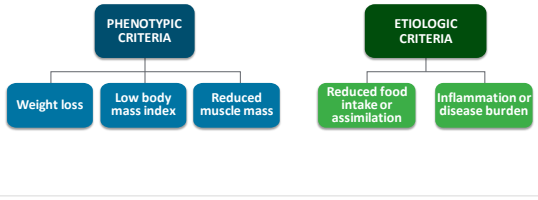


Kaegi-Braun N, et al. *JAMA Network Open*. 2021;4(1):e2033433.

9

GLOBAL LEADERSHIP INITIATIVE ON MALNUTRITION (GLIM)

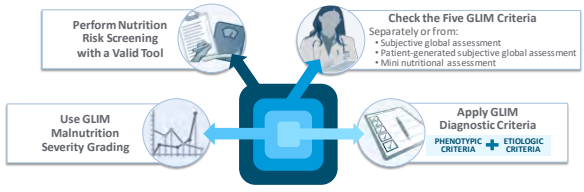
Global Consensus on Diagnostic Criteria to Support Benchmarking and Amend the Malnutrition Description in ICD-11



Cederholm T, et al. *Clin Nutr.* 2019;38(1):1-9.
Jensen GL, et al. *J Parenter Enteral Nutr.* 2019;43:32-40.

10

GLIM WITHIN NUTRITION CARE



GLIM is to be used alongside screening and nutritional assessment
It is not a replacement for these steps

11

MUSCLE LOSS

12

PATHOPHYSIOLOGY OF MUSCLE LOSS

MUSCLE WASTING

- Insulin resistance
- Inflammation
- Oxidative stress
- Mitochondrial damage

Duan K, et al. *Clin Nutr.* 2021;40(1):27-37.
Kalyani RR, et al. *Lancet Diabetes Endocrinol.* 2014;2(10):819-829.

13

MUSCLE LOSS: THE COMMON FEATURE AMONG DIFFERENT CLINICAL CONDITIONS

Muscle Loss

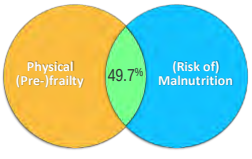
MALNUTRITION	SARCOPENIA/FRAILTY	CACHEXIA
• Weight loss • Low BMI • Reduced food intake • Inflammation/disease	• Reductions in strength & performance	• Weight loss • Reductions in muscle strength • Fatigue • Anorexia • Inflammatory markers

BMI- Body Mass Index

14

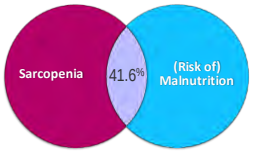
MALNUTRITION, SARCOPENIA & FRAILTY: OVERLAPPING SITUATIONS IN HOSPITALIZED OLDER ADULTS

10 STUDIES, N=2427



OR: 5.77 (95% CI: 3.88, 8.58), P<0.0001, I²=42.3%

7 STUDIES, N=2506

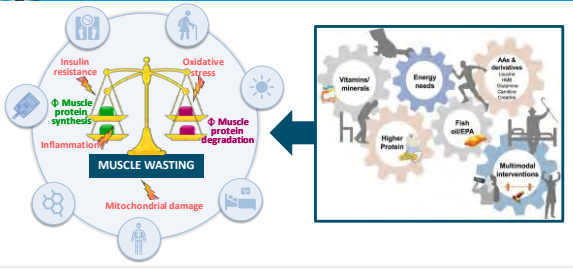


OR: 4.06 (95% CI: 2.43, 6.80), P<0.0001, I²=71.4%

Ligthart-Melis GC, et al. *JAMDA.* 2020;21:1216-1228.

15

CONTINUING INTERVENTIONS FOR PREVENTING AND TREATING MUSCLE LOSS



Prado CM, et al. *J Cachexia Sarcopenia Muscle.* 2021;12(1):3-8; Cruz-Jentoft AJ, et al. *Maturitas.* 2020;132:57-64; Duan K, et al. *Clin Nutr.* 2021;40(1):27-37; Kalyani RR, et al. *Lancet Diabetes Endocrinol.* 2014;2(10):819-829.

EPA- Eicosapentaenoic Acid
AA- Amino Acid

16

16

RECENT ADVANCES IN MUSCLE MASS ASSESSMENT

17

17

OVERALL PERFORMANCE OF MOST COMMONLY USED TECHNIQUES

DXA	☺	☺	☹
Anthropometrics	☹	😐	😐
CT	☺	😐	☹
Ultrasound	😐	😐	☹
BIA	😐	😐	😐

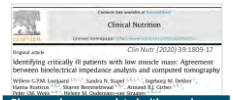
Duan K, et al. *Clin Nutr.* 2021;40(1):27-37; Mundi MP, et al. *Nutr Clin Pract.* 2019;34(1):48-58. Deutz NEP, et al. *JAMDA.* 2019;20(1):22-27.

DXA- Dual-Energy X-ray Absorptiometry
CT- Computed Tomography

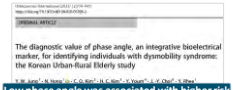
18

18

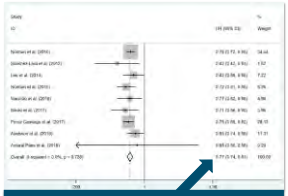
PHASE ANGLE AS A MARKER OF LOW MUSCLE MASS AND ADVERSE CLINICAL OUTCOMES



Phase angle was correlated with muscle area and radiodensity by CT



Low phase angle was associated with higher risk of dysmobility



Among adult patients with cancer, those with low phase angle were 23% less likely to survive than those with high phase angle

ANHI Arab A, et al. *Clin Nutr.* 2021;40(5):3182-3190. Abbott 19

19

CALF CIRCUMFERENCE

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20

20

WHY MEASURE CALF CIRCUMFERENCE?

Most used tool for assessment of muscle mass component for sarcopenia assessment in clinical practice

High correlation with direct and indirect measures of skeletal muscle

Ability to capture age-associated muscle loss: muscles in the lower limbs are lost faster than in the upper limbs

ANHI Bruyère O, et al. *Eur Ger Med.* 2016;7(3):243-246.
Tresignie J, et al. *Am J Human Biol.* 2013;25(5):637-642.
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21

KEY FACTORS AFFECTING CALF CIRCUMFERENCE MEASURES

SEX | RACE/ETHNICITY | BMI | EDEMA

- Cut-off values should be sex and population-specific
- Correction for edema: ♂ -2.0 cm ♀ -1.6cm
- BMI?

Santos LP & Gonzalez MC, et al. *JPEN J Parenter Enteral Nutr.* 2019;43(8):998-1007.
Ishida Y, et al. *Geriatr Gerontol Int.* 2019;19(10):993-998.

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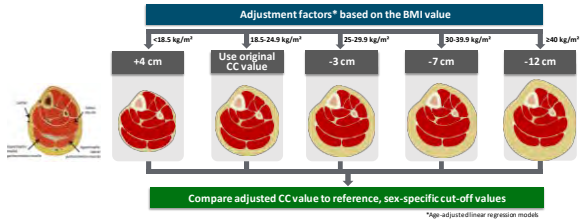
22

DIAGNOSIS OF REDUCED MUSCLE MASS – CALF CIRCUMFERENCE



Gonzalez MC, et al. *Am J Clin Nutr.* 2021;113:1679-1687.

CC- Calf Circumference

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23

CALF CIRCUMFERENCE CUT-POINTS: MARKER OF LOW MUSCLE MASS

Population	n	Cut-off values Men	Cut-off values Women	Study
France +70 y ♂	1311	---	< 31 cm	Rolland Y, et al. *J A Geriatr Soc.* 2003;51(8):1120- 1124.
Japan +40 y	526	< 34 cm	< 33 cm	Kawakami R, et al. *Geriatr Gerontol Int.* 2015;15(8):969-976.
Brazil +60 y	189	≤ 34 cm	≤ 33 cm	Barbosa-Silva TG, et al. *J Cachexia Sarcopenia Muscle.* 2016;7(2):136-143.
Turkey +60 y	406	< 33 cm	< 33 cm	Bahat G, et al. *Clin Nutr.* 2016;35(6):1557-1563.
Taiwan +50 y	1839	< 33 cm	< 32 cm	Hwang AC, et al. *J Am Med Dir Assoc.* 2018;19(2):182-184.
Korea +70 y	657	< 35 cm	< 33 cm	Kim S, et al. *J Korean Med Sci.* 2018;33(20):e151.
South Africa +45 y ♂	247	---	< 30 cm	Ukegbu PO, et al. *JEMDSA.* 2018;23(3):86-90.
Japan +40 y	1239	< 36 cm	< 34 cm	Kawakami R, et al. *Geriatr Gerontol Int.* 2020;20(10):943-950.
United States 18–39 y	3104	< 34 cm	< 33 cm	Gonzalez MC, et al. *Am J Clin Nutr.* 2021;113(6):1679-1687.

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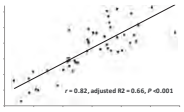
24

THE USE OF ULTRASOUND FOR MUSCLE MASS ASSESSMENT

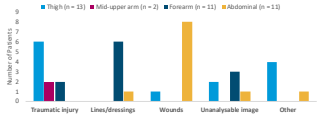
Original Communication JPEN 2021;45:136-45

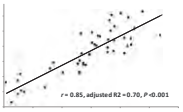
Comparison of Ultrasound-Derived Muscle Thickness With Computed Tomography Muscle Cross-Sectional Area on Admission to the Intensive Care Unit: A Pilot Cross-Sectional Study

Kate J. Lambell, MNutrDiet; Audrey C. Tierney, PhD; Jessica C. Wang, MD; Vinodh Nanjayya, MD; Adrienne Forsyth, PhD; Gerard S. Gah, MD; Don Vicendese, PhD; Emma J. Ridley, PhD; Selina M. Parry, PhD; Marina Mourtzakis, PhD; and Susannah J. King, PhD



REASONS FOR MISSING ULTRASOUND DATA





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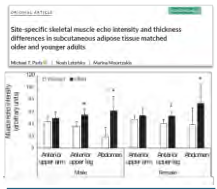
25

NOT ONLY IS MUSCLE MASS IMPORTANT...



MYOSTEATOSIS: SITE AND AGE-RELATED DIFFERENCES

*Main effects compared with younger adults

MYOSTEATOSIS

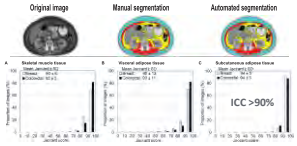
40 STUDIES (21,222 PATIENTS) MYOSTEATOSIS: 75% HIGHER MORTALITY RISK

ANHI Paris MT, et al. *Clin Physiol Funct Imaging*. 2021;41(2):156-164. Aleixo GFP, et al. *Crit Rev Oncol Hematol*. 2020;145:102839. Abbott 26

26

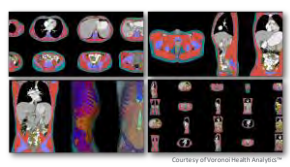
AUTOMATED BODY COMPOSITION ANALYSIS BY COMPUTED TOMOGRAPHY & 3D-COMPUTED TOMOGRAPHY

Patients with Colorectal Cancer (n=3102) and Breast Cancer (n=2888)



Similar associations between mortality and body composition parameters from manual and automated CT segmentation

DAFS 3.0: Automated Analysis



Courtesy of Voronoi Health Analytics™

ANHI Cespedes Feliciano EM, et al. *J Cachexia Sarcopenia Muscle*. 2020;11(5):1258-1269.

ICC-Intraclass Correlation Coefficient; DAFS 3.0-3rd generation platform artificial intelligent assisted medical image analysis

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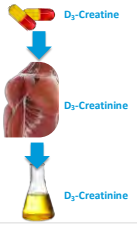
27

D_3-CREATINE DILUTION FOR MUSCLE MASS ASSESSMENT

Muscle Mass Measurement by D_3 CR Dilution



Postmenopausal women (n=74)[1]

- Moderate correlations with lean mass measures by DXA (r=0.50)
- Strong associations with physical function determined by SPPB (OR=5.24, 95% CI=1.40-19.58)

Older men (n=903)[2]

- Positive associations with total protein (β=0.09, 95% CI=0.03, 0.14)
- Positive associations with nondairy animal protein (β=0.09, 95% CI=0.03, 0.14)

1. Zhu K, et al. *J Gerontol A Biol Sci Med Sci*. Fothcoming 2021.
2. Rogers-Soeder TS, et al. *J Gerontol A Biol Sci Med Sci*. 2020;75(7):1353-1361.

D_3-Cr- Cholecalciferol Creatine Dilution
SPPB- Short Physical Performance Battery

28

28

FINAL REMARKS

29

29

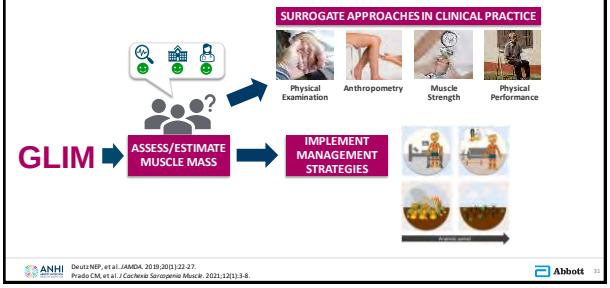
SUMMARY

- Malnutrition has been associated with unfavourable changes in body composition and several adverse health outcomes
- The GLIM framework has been proposed to aid malnutrition diagnosis, and it should be used alongside screening and nutrition assessment
- Muscle loss is one of the most critical consequences of malnutrition
  - It is easier to prevent muscle loss than to rebuild muscle
- Several techniques have been proposed to assess muscle mass: research vs. clinical practice

30

30

TAKE HOME MESSAGES



Deutz NEP, et al. JAMDA. 2019;20(1):22-27.
Prado CM, et al. J Cachexia Sarcopenia Muscle. 2021;12(1):3-8.

31

THANK YOU

32

MALNUTRITION AND MUSCLE LOSS: IMMUNITY/COVID-19

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CHIEF, GERIATRIC REHABILITATION UNIT
A. GEMELLI UNIVERSITY HOSPITAL
ROME, ITALY

33

DISCLOSURES

The content of this program has met the (continuing education) criteria of being evidence-based, fair and balanced, and non-promotional

This educational event is supported by Abbott Nutrition Health Institute, Abbott Nutrition

Disclosures for **Francesco Landi, MD, PhD** include:

- Congress invitation from Abbott and Nutricia
- Honoria for speaking engagement from Abbott

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34

LEARNING OBJECTIVES

1. Describe the relationship between COVID-19 and the nutrition status of patients
2. Review new data on COVID-19, and its implications for nutrition care - from hospital to home
3. Translate current knowledge for the nutritional management of COVID-19 patients into practical guidance for clinicians

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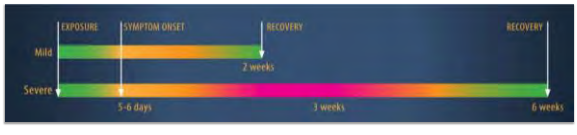
35

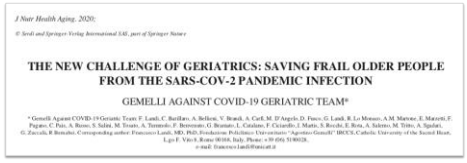
World Health Organization



ANHI World Health Organization. Accessed 6.21.21. https://www.who.int/emergencies/diseases/novel-coronavirus-2019 Abbott 36

36

ITALIAN EXPERIENCE



J Nutr Health Aging. 2020;

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THE NEW CHALLENGE OF GERIATRICS: SAVING FRAIL OLDER PEOPLE FROM THE SARS-COV-2 PANDEMIC INFECTION

GEMELLI AGAINST COVID-19 GERIATRIC TEAM*

* Gemelli Against COVID-19 Geriatric Team: F. Landi, C. Barillaro, A. Bellieni, V. Brandi, A. Carfì, M. D'Angelo, D. Fusco, G. Landi, R. Lo Monaco, A.M. Martone, E. Marzetti, F. Pagano, C. Pais, A. Russo, S. Salini, M. Tosato, A. Tummolo, F. Bernabei, G. Bramato, L. Catalano, F. Ciciarello, J. Matto, S. Recchi, E. Rosa, A. Salerno, M. Tritto, A. Sgadari, G. Zuccalà, R Bentivoi. Corresponding author: Francesco Landi, MD, PhD, Fondazione Policlinico Universitario "Agostino Gemelli" IRCCS, Catholic University of the Sacred Heart, Largo F. Vito 8, Roma 00168, Italy. Phone: +39 (06) 3015 4028, e-mail: francesco.landi@unicatt.it

37

ITALIAN EXPERIENCE

Clinical Features

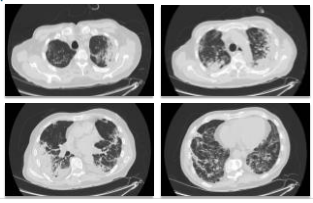
- The range of clinical presentations of COVID-19 disease have been described varying from asymptomatic infection to severe respiratory failure
- The common clinical manifestations include fever, cough, fatigue, myalgia, shortness of breath, sore throat, and headache
- In addition, patients may have also gastrointestinal symptoms, with diarrhea and vomiting
- Some patients may have taste and smell disturbances, too
- Interstitial pneumonia is present in most COVID-19 patients

38

ITALIAN EXPERIENCE

Antero-posterior chest radiograph shows patchy ground-glass opacities (78-year-old man)

Chest CT shows diffuse ground-glass opacities, consolidation area, and both ground-glass opacities with consolidation



39

ITALIAN EXPERIENCE

Practical Features

- New disease
- New department (ex, surgical units)
- Patient's isolation
- Protective Personal Equipment (PPE)
- Management of specific symptoms (nausea, diarrhea and vomiting)
- Drugs side effects
- Oxygen therapy

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40

SARS-COV-2 INFECTION

IMPACT ON HEALTH OUTCOMES

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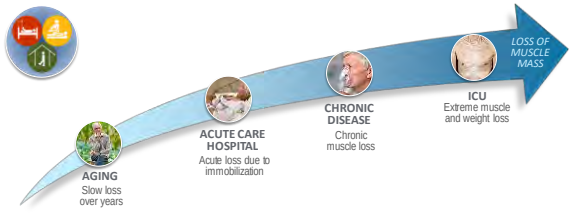
41

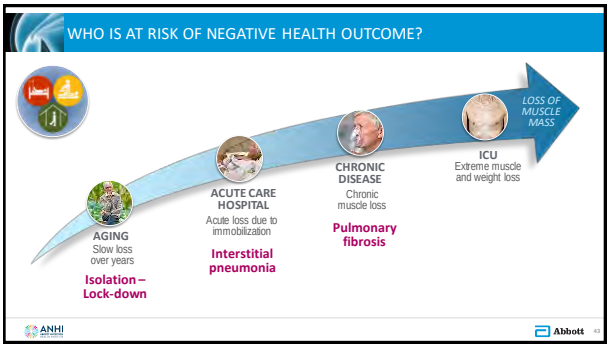
41

WHO IS AT RISK OF NEGATIVE HEALTH OUTCOME?

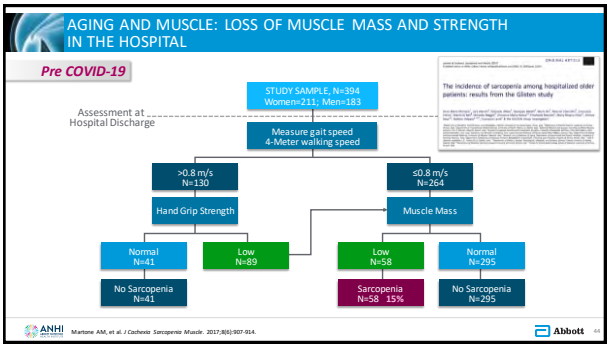


ANHI ICU-Intensive Care Unit Abbott 42

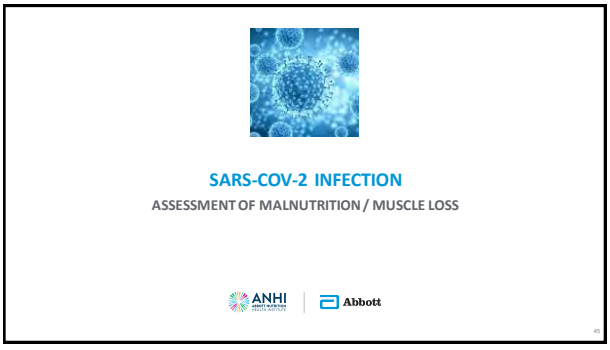
42


WHO IS AT RISK OF NEGATIVE HEALTH OUTCOME?
AGING
Slow loss over years
Isolation – Lock-down
ACUTE CARE HOSPITAL
Acute loss due to immobilization
Interstitial pneumonia
CHRONIC DISEASE
Chronic muscle loss
Pulmonary fibrosis
ICU
Extreme muscle and weight loss
LOSS OF MUSCLE MASS
ANHI
Abbott
43

43


AGING AND MUSCLE: LOSS OF MUSCLE MASS AND STRENGTH IN THE HOSPITAL
Pre COVID-19
Assessment at Hospital Discharge
STUDY SAMPLE, N=394
Women=211; Men=183
Measure gait speed 4-Meter walking speed
>0.8 m/s N=130
≤0.8 m/s N=264
Hand Grip Strength
Muscle Mass
Normal N=41
Low N=89
Low N=58
Normal N=295
No Sarcopenia N=41
Sarcopenia N=58 15%
No Sarcopenia N=295
The incidence of sarcopenia among hospitalized older patients: results from the Glisten study
ANHI
Martone AM, et al. J Cachexia Sarcopenia Muscle. 2017;8(6):907-914.
Abbott
44

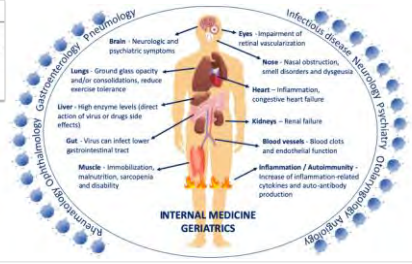
44


SARS-COV-2 INFECTION
ASSESSMENT OF MALNUTRITION / MUSCLE LOSS
ANHI
Abbott
45

45

ASSESSMENT IN CLINICAL PRACTICE

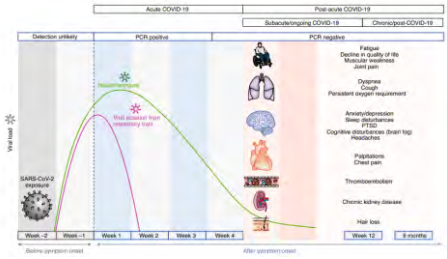
Post-COVID-19 global health strategies: the need for an interdisciplinary approach



ANHI Gemelli Against COVID-19 Post-Acute Care Study Group. *Aging Clin Exp Res.* 2020;32(8):1613-1620. Abbott 46

46

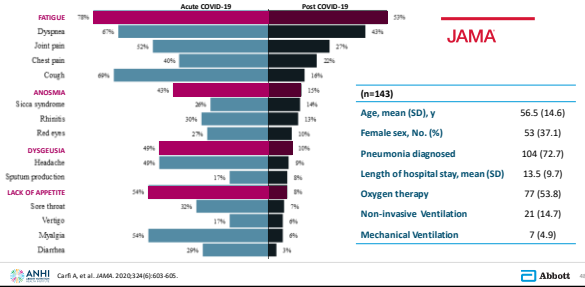
nature medicine FOCUS | REVIEW ARTICLE



ANHI Nalbandian A, et al. *Nat Med.* 2021;27(4):601-615. SARS-CoV-2- Severe Acute Respiratory Syndrome Coronavirus 2 PCR- Polymerase Chain Reaction Abbott 47

47

ASSESSMENT IN CLINICAL PRACTICE



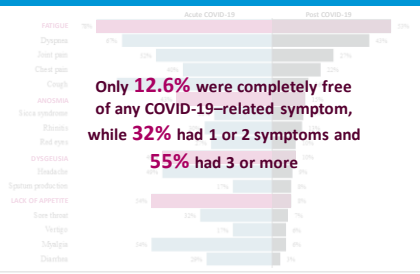
JAMA

(n=143)	
Age, mean (SD), y	56.5 (14.6)
Female sex, No. (%)	53 (37.1)
Pneumonia diagnosed	104 (72.7)
Length of hospital stay, mean (SD)	13.5 (9.7)
Oxygen therapy	77 (53.8)
Non-invasive Ventilation	21 (14.7)
Mechanical Ventilation	7 (4.9)

ANHI Carfì A, et al. *JAMA.* 2020;324(6):603-605. Abbott 48

48

ASSESSMENT IN CLINICAL PRACTICE

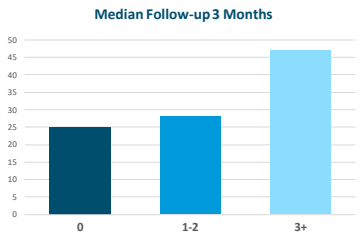


Only **12.6%** were completely free of any COVID-19–related symptom, while **32%** had 1 or 2 symptoms and **55%** had 3 or more

49

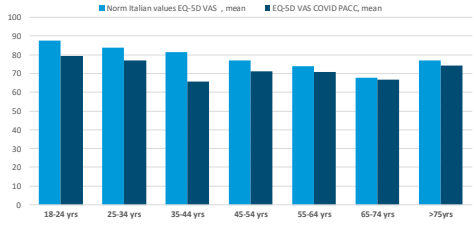
NUMBER OF SYMPTOMS

Patients	1343
Age, mean (SD), y	50 (±17)
Female sex, No. (%)	665 (49,5%)
BMI	25.8 (±4.4)
Flu vaccination	309 (23%)
Cardiovascular disease	107 (8%)
Hypertension	376 (28%)
Diabetes	108 (8%)
BPCO	105 (8%)
Number of drugs	2 (±2)
Hospitalized	739 (55%)
ICU	161 (12%)



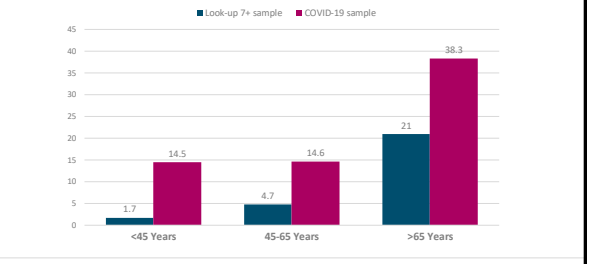
50

QUALITY OF LIFE EQ5D VAS



51

ASSESSMENT IN CLINICAL PRACTICE (SARCOPENIA)



ANHI Landi F, et al. Submitted. Abbott 52

52

MALNUTRITION

ESPEN
European Society for Clinical Nutrition and Metabolism

Editorial

ESPEN expert statements and practical guidance for nutritional management of individuals with SARS-CoV-2 infection

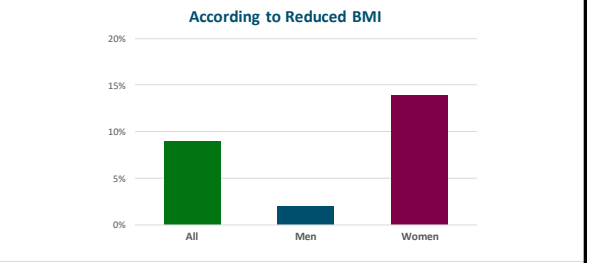
Table 1
Phenotypic and etiologic criteria for the diagnosis of malnutrition

Phenotypic Criteria		Etiologic Criteria	
Weight loss (%)	>5% within past 6 months or >10% beyond 6 months	Reduced food intake or assimilation	50% of ER > 1 week, or any reduction for >2 weeks; or any chronic GI condition that adversely impacts food assimilation or absorption
Low body mass index (kg/m2)	<20 if <70 years; or <22 if >70 years. Asia: <18.5 if < 70 years, or <20 if >70 years	Inflammation	Acute disease/ injuries; or chronic disease-related
Reduced muscle mass	Reduced by validated body composition measuring technique		

ANHI Barazzoni R, et al. *Clin Nutr*. 2020;39(6):1631-1638. Abbott 53

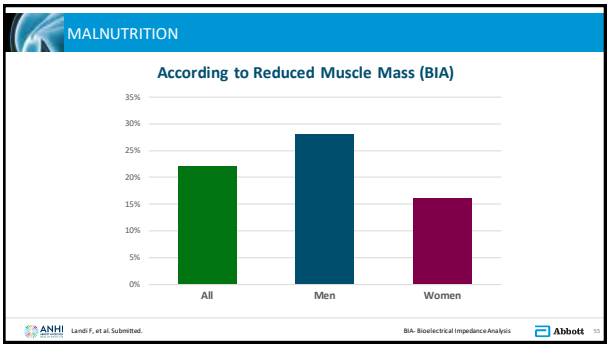
53

MALNUTRITION

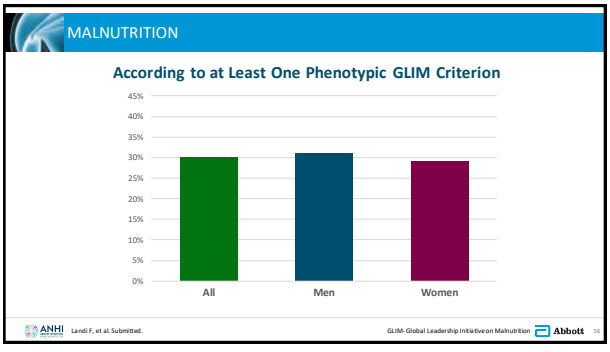


ANHI Landi F, et al. Submitted. BMI- Body Mass Index Abbott 54

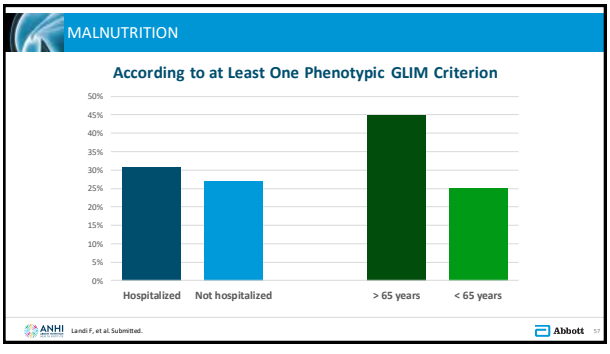
54


MALNUTRITION
According to Reduced Muscle Mass (BIA)
35%
30%
25%
20%
15%
10%
5%
0%
All
Men
Women
ANHI
Landi F, et al. Submitted.
BIA- Bioelectrical Impedance Analysis
Abbott
55

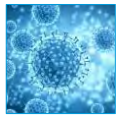
55


MALNUTRITION
According to at Least One Phenotypic GLIM Criterion
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
All
Men
Women
ANHI
Landi F, et al. Submitted.
GLIM- Global Leadership Initiative on Malnutrition
Abbott
56

56


MALNUTRITION
According to at Least One Phenotypic GLIM Criterion
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Hospitalized
Not hospitalized
> 65 years
< 65 years
ANHI
Landi F, et al. Submitted.
Abbott
57

57



SARS-COV-2 INFECTION

THE IMPORTANCE OF ASSESSMENT

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58

58

SCREENING / ASSESSMENT / INTERVENTION

Screen/Assess

Mandatory in COVID-19 patients

Intervention

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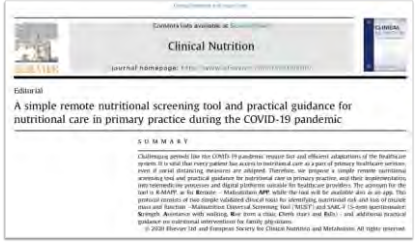
59

59

ASSESSMENT IN CLINICAL PRACTICE



Clinical Nutrition

Editorial

A simple remote nutritional screening tool and practical guidance for nutritional care in primary practice during the COVID-19 pandemic

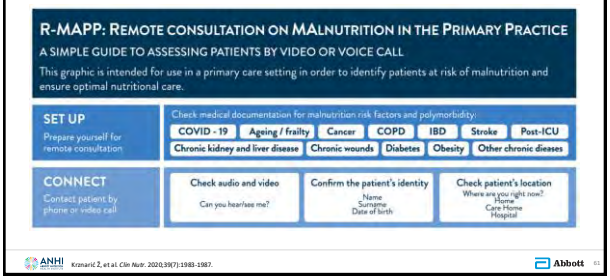
SUMMARY

ANHI Kronarić Ž, et al. *Clin Nutr.* 2020;39(7):1983-1987. Abbott

60

60

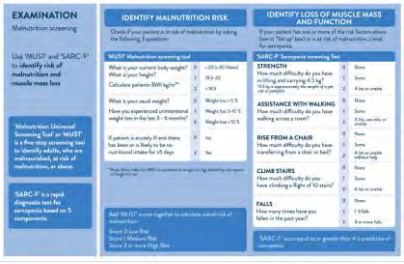
ASSESSMENT IN CLINICAL PRACTICE: R-MAPP



Kranarić Z, et al. *Clin Nutr*. 2020;39(7):1983-1987.

61

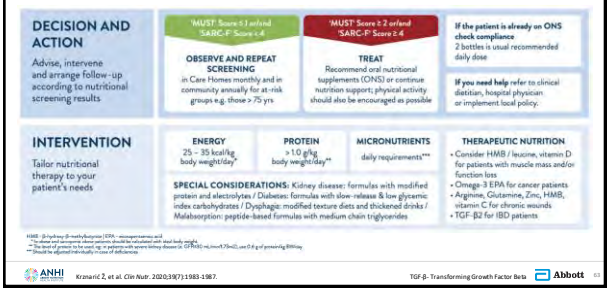
ASSESSMENT IN CLINICAL PRACTICE: R-MAPP (cont.)



Kranarić Z, et al. *Clin Nutr*. 2020;39(7):1983-1987.

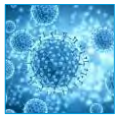
62

ASSESSMENT IN CLINICAL PRACTICE: R-MAPP (cont.)



Kranarić Z, et al. *Clin Nutr*. 2020;39(7):1983-1987.

63



SARS-COV-2 INFECTION

THE IMPORTANCE OF FOLLOW-UP

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64

64

POST ACUTE CARE ORGANIZATION

ANHI Abbott 65

65

POST ACUTE CARE ORGANIZATION

First Day	Second Day	Third Day
Clinical History	Chest CT	Neurology
Performance tests	Pulmonary function tests	Psychiatry
ECG	Pneumology	Rheumatology
Laboratory tests	Gastroenterology	Angiology
Echocardiogram	Otolarynringology	NUTRITIONIST
BIA	Dermatology	Internal medicine/ geriatrics

ANHI

ECG- Electrocardiogram Abbott 66

66


GEMELLI AGAINST COVID-19 – PATIENT FOLLOW UP
TIME
A Year Into the Pandemic, Long COVID Is Still Burdening Patients—and Their Caregivers
Persistent Symptoms in Patients After Acute COVID-19
BBC NEWS
TIME
A Year Into the Pandemic, Long COVID Is Still Burdening Patients—and Their Caregivers
D.H. POST COVID
The Washington Post
ANHI
Abbott

67


GEMELLI AGAINST COVID-19 – PATIENT FOLLOW UP
This photographer shows us how the long-term effects of covid-19 are being studied at a hospital in Rome
ANHI
Abbott

68


GEMELLI AGAINST COVID-19 – PATIENT FOLLOW UP
ANHI
Abbott

69

SUMMARY

- ✓Risk for malnutrition affects a large proportion of the polymorbid medical inpatient population and it is important in COVID-19 patients
- ✓Sarcopenia and malnutrition are frequent in COVID-19 and have negative impact on short- and long-term outcomes
- ✓Screening with validated tools is effective to identify patients at risk who benefit from nutritional support
- ✓New multicenter trials provide high level evidence that early start of nutritional support is highly effective in reducing malnutrition-associated complications and mortality
- ✓Now it is time to ACT in all patients, health care settings and in COVID-19!

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70

THANK YOU

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71

71

ANHI ABBOTT NUTRITION HEALTH INSTITUTE | Abbott

MALNUTRITION AND MUSCLE LOSS: HEALTHY AGING/SARCOPENIA/FRAILTY

SAMUEL TH CHEW, MB, BCH, BAO, FRCP, FAMS
ADJ ASSOCIATE PROFESSOR MEDICINE
SENIOR CONSULTANT GERIATRICIAN
CHANGI GENERAL HOSPITAL, SINGAPORE

72

72

DISCLOSURE

The content of this program has met the (continuing education) criteria of being evidence-based, fair and balanced, and non-promotional

This educational event is supported by Abbott Nutrition Health Institute, Abbott Nutrition

Disclosures for **Samuel TH Chew** include:

- Honoria for speaking engagement from Abbott

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73

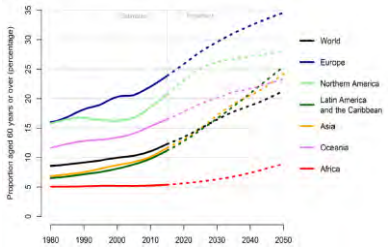
OBJECTIVES

1. Describe the effect of aging on muscle health, eating habits and nutrition knowledge among community-dwelling older adults
2. Compare and contrast conditions of sarcopenia and frailty, and describe assessment methods for each condition in the community setting
3. Explain the effects of nutrition intervention on muscle and strength overtime [as observed in the SHIELD study]

ANHI SHIELD- Strengthening Health in ELDerly through Nutrition Abbott 74

74

RAPID POPULATION AGING IS A GLOBAL PHENOMENON



ANHI United Nations. 2017. Accessed 6.20.21. https://www.un.org/en/development/desa/population/theme/ageing/WPA2017.asp Abbott 75

75

MORE THAN HALF OF THE WORLD'S OLDER PEOPLE LIVE IN ASIA

Asia: 2-Fold Increase in the Number of Older Persons

	Number of Persons Aged 60 Years or Older in 2017 (Millions)	Number of Persons Aged 60 Years or Over in 2050 (Millions)	Percentage Change Between 2017 and 2050	Distribution of Older Persons in 2017 (Percentage)	Distribution of Older Persons in 2050 (Percentage)
World	962.3	2080.5	116.2	100.0	100.0
Africa	68.7	225.8	228.5	7.1	10.9
Asia	**549.2**	**1273.2**	**131.8**	**57.1**	**61.2**
Europe	183.0	247.2	35.1	19.0	11.9
Northern America	78.4	122.8	56.7	8.1	5.9
Latin America and the Caribbean	76.0	198.2	160.7	7.9	9.5
Oceania	6.9	13.3	92.6	0.7	0.6

ANHI United Nations. 2017. Accessed 6.20.21. https://www.un.org/en/development/desa/population/theme/ageing/WPA2017.asp Abbott 76

76

SHIFTING THE FOCUS

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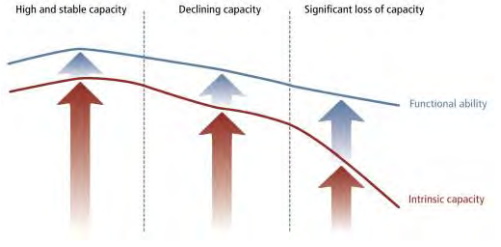
77

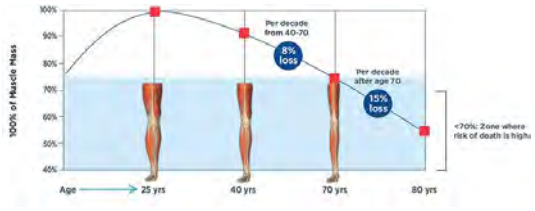
FUNCTIONAL ABILITY OVER TIME: INTEGRATED CARE OLDER PEOPLE WHO 2017



ANHI World Health Organization. 2017. Accessed 6/20/21. https://www.ncbi.nlm.nih.gov/books/NBK488252/ Abbott 78

78

LOSS OF LEAN BODY MASS OVER TIME



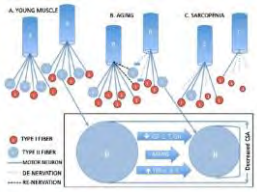
Vandewoude MF, et al. *J Aging Res.* 2012;2012:651570.
Janssen I, et al. *J Appl Physiol.* 2000;89(1):81-88.
Grimby G, Saltin B. *Clin Physiol.* 1983;3(3):209-218.

79

AETIOLOGY SARCOPENIA: CHANGE IN MUSCLE PROPERTIES AND MORPHOLOGY WITH AGING

Motor Units

- Slow (Type I Myosin)
  - Myoglobin
  - Mitochondria
- Fast (Type II Myosin)
  - Glycolysis
  - Large Cross Sectional Area (CSA)
  - 4X more power
  - Generates more reactive oxygen species and more mitochondrial damage and dysfunction
- Age related loss
  - 8% loss/decade: 40 to 70 years old
  - 15% loss/decade: >70 years old



Lang T, et al. *Osteoporos Int.* 2010;21(4):543-559.
Harper C, et al. *J Transl Med.* 2021;19(1):71.

IGF-1-Insulin-like Growth Factor 1; GH-growth hormone; TNF-α- Tumor Necrosis Factor Alpha; IL- Interleukin

80

ANOREXIA OF AGING

Anorexia of Aging

- Loss of appetite and/or decreased food intake in later life
- Unintentional decline in intake
- Altered satiety and hunger physiology (ghrelin vs leptin)
- Gastrointestinal motility changes
- Other physical, socioeconomic factors and impaired cognition

Landi F, et al. *Nutrients.* 2016;8(2):69.

81

EATING HABITS AND NUTRITION KNOWLEDGE

- Factors related to better nutrition knowledge
  - Female
  - Able to access and understand nutrition information important[1-3]
  - Media and social network most common source of information in Asian setting[1]
- Impact of popular diet and misconceptions
  - Older people don't need as much nutrition as young people
  - The lighter an older person is the better
  - Avoidance of "cold" and "heaty" food[1]
  - Self-imposed "extreme diets"
- Impact of socioeconomic factors, lost of sense of smell and taste, and poor dentition[1]

1. Lin W, et al. *Asia Pac J Clin Nutr.* 2005;14(3):221-229; 2. Jeruszka-Bielak M, et al. *Front Physiol.* 2018;9:994; 3. Woo J, et al. *Translational Medicine of Aging.* 2019;3:125-131; 4. Wang S, et al. *Int J Environ Res Public Health.* 2020;17(21):8029.

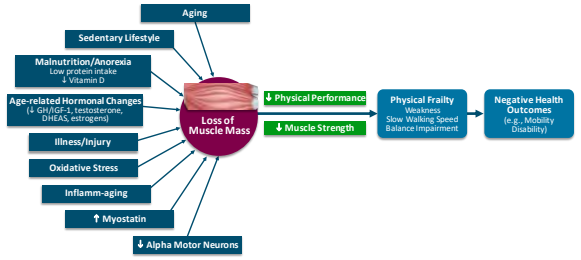
82

SARCOPENIA AND FRAILTY

CONTRAST AND ASSESSMENT

83

SARCOPENIA AND FRAILTY



Landi F, et al. *Eur Geriatr Med.* 2016;7(3):197-200.

GH-Growth Hormone
IGF-1- Insulin-Like Growth Factor 1
DHEAS- Dehydroepiandrosterone Sulfate

84

SARCOPENIA VS FRAILTY

SARCOPENIA	FRAILTY[6]
• A disease • Has ICD-10-CM code[1] • Diagnostic criteria established[2,3] – EWGSOP – AWGS • Targeted interventions[2-4] – Muscle health (mass and function) – Nutrition – Fixed measurable targets • Predicts adverse outcomes – Precedes frailty[5]	• A clinical state/syndrome • Multiple models[7] – Defined as a phenotype (Fried's criteria) or – Defined as accumulation of deficits (Frailty Index) or – Defined as multi-dimensional construct • May require further assessment to determine underlying causes • Interventions are based on each of these causes • Predicts adverse outcomes – Precedes disability

ICD-10-CM- International Classification of Diseases, Tenth Revision, Clinical Modification; EWGSOP- The European Working Group on Sarcopenia in Older People; AWGS- Asian Working Group for Sarcopenia

1. Cao L, et al. *J Am Med Dir Assoc.* 2016;17(8):675-677; 2. Cruz-Jentoft AJ, et al. *Age Ageing.* 2019;48(1):16-31; 3. Chen LK, et al. *J Am Med Dir Assoc.* 2020;21(3):300-307.e2; 4. Chew STH, et al. *BMC Geriatr.* 2021;21(1):314; 5. Landi F, et al. *Eur Geriatr Med.* 2016;7(3):197-200; 6. Dent E, et al. *J Nutr Health Aging.* 2018;22(10):1148-1161; 7. Cesari M, et al. *Age Ageing.* 2014;43(1):10-12.

85

FRAILTY: SCREENING AND ASSESSMENT TOOLS

Clinical Frailty Scale (1-2 mins)
- Easy, validated, reliable
- Summary of Frailty Index
- Non-frail (1-4), Mild-to-moderately frail (5-6), Severely frail (7-8), Terminally ill (9)
- A continuous scale

Fried's Criteria/ Frailty Phenotype
- 5 factors
  - Weight loss, exhaustion, sedentary, handgrip strength, gait speed
- Frail (≥3)
- A categorical scale

Rockwood K, et al. *CMAJ.* 2005;173(5):489-495.
Cesari M, et al. *Age Ageing.* 2014;43(1):10-12.

86

ASSESSMENT MUSCLE HEALTH

- Definitions[1]
  - Muscle health
    - Muscle Function + Muscle Mass
  - Muscle function
    - Muscle Strength +/Or Performance
- Screening[2]
  - Malnutrition Universal Screening Tool (MUST)[3]
  - SARC-F questionnaire[4]
- Strength and Performance
  - Handgrip strength[5,6]
  - 5-times Chair Stand Test (5CST)[2,5,6]
  - 6-m Gait Speed / Short Physical Performance Battery[5,6]
- Muscle Mass
  - Assessment of the Appendicular Skeletal Muscle Mass (ASM)
  - Bio-electrical Impedance Analysis
  - Dual-energy X-ray Absorptiometry (DEXA)

SARC-F- Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls

1. Chew STH, et al. *BMC Geriatr.* 2021;21(1):314; 2. Dent E, et al. *J Nutr Health Aging.* 2018;22:1148-1161; 3. Stratton RJ, et al. *Br J Nutr.* 2004;92(5):799-808; 4. Malmstrom TK, et al. *J Cachexia Sarcopenia Muscle.* 2016;7(1):28-36; 5. Cruz-Jentoft AJ, et al. *Age Ageing.* 2019;48:16-31; 6. Chen LK, et al. *J Am Med Dir Assoc.* 2020;21(3):300-307.e2

87

DIAGNOSIS OF SARCOPENIA[1,2]

Possible/Probable Sarcopenia
- SARC-F (≥4) + Low Muscle Strength (or Low Muscle Performance)

Sarcopenia Confirmed
- Low Muscle Mass + Low Muscle Strength (or Low Muscle Performance)

Severe Sarcopenia
- Low Muscle Mass + Low Muscle Strength + Low Muscle Performance

Cruz-Jentoft AJ, et al. *Age Ageing*. 2019;48:16–31.
Chen LK, et al. *J Am Med Dir Assoc*. 2020;21(3):300-307.e2.

88

SARCOPENIA AND FRAILTY

RESISTANCE EXERCISE TRAINING AND NUTRITION

89

RESISTANCE EXERCISE TRAINING (RET)

- First-line intervention older adults with sarcopenia[1]
- Frequency, volume and duration dependent[2]
  - Increases strength, power, gait speed and muscle mass[3]
  - ≥3 months duration, ≥2 sessions per week
- 1-Repetition Maximum (1-RM)
  - Gold standard for assessment of muscle strength in non-laboratory settings
  - 60% 1-RM[3]
    - Minimum muscle load for sustained long term improvement in strength and muscle mass
- Dose response relationship between volume and intensity of RET with muscle mass and muscle strength respectively[4]

1. Dent E, et al. *J Nutr Health Aging*. 2018;22:1148-1161; 2. World Health Organization. 2020. Accessed 6/20/21. https://www.who.int/publications/i/item/9789240015128; 3. Avers D, et al. *J Geriatr Phys Ther*. 2009;32(4):148-158;4. Levinger I, et al. *J Sci Med Sport*.

90

WHO GUIDELINES ON PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR AND WHAT IT MEANS IN TARGETED PRACTICE

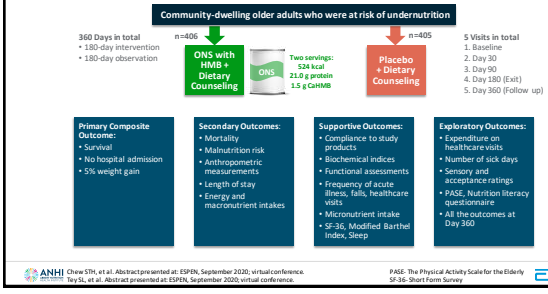
1. World Health Organization. 2020. Accessed 6/20/21. https://www.who.int/publications/i/item/9789240015128
2. Chew STH, et al. *BMC Geriatr.* 2021;21(1):314.

STRENGTHENING HEALTH IN ELDERLY THROUGH NUTRITION (SHIELD) STUDY

Objective:
To determine the effects of oral nutritional supplement (ONS) containing beta-hydroxy-beta-methylbutyrate (HMB) with dietary counselling on health outcomes in community-dwelling older adults at risk of malnutrition

Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892.

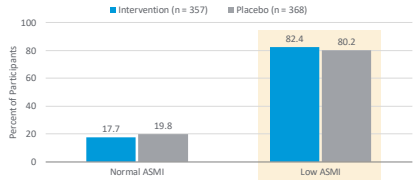
STRENGTHENING HEALTH IN ELDERLY THROUGH NUTRITION STUDY



Chew STH, et al. Abstract presented at: ESPEN, September 2020; virtual conference.
Tey SL, et al. Abstract presented at: ESPEN, September 2020; virtual conference.

PASE- The Physical Activity Scale for the Elderly
SF-36- Short Form Survey

4 IN 5 OLDER ADULTS AT RISK OF MALNUTRITION HAVE LOW MUSCLE MASS AT BASELINE[1]

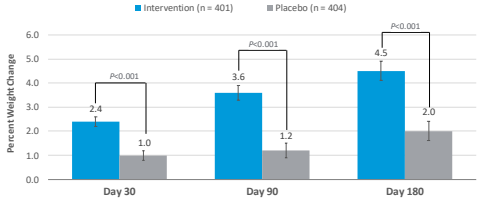


Low Appendicular Skeletal Muscle Mass Index (ASMI) is associated with multiple morbidities such as impaired immunity, decreased wound healing capacity, increased incidence of pneumonia, and mortality[2-4]

1. Chew STH, et al. *Clin Nutr*. 2021;40(4):1879-1892; 2. Landi F, et al. *Clin Nutr*. 2019;38(5):2113-2120; 3. Deutz NEP, et al. *J Am Med Dir Assoc*. 2019;20(1):22-27; 4. Demling RH. *Eplasty*. 2010;9:e9.

94

INTERVENTION GROUP HAD SIGNIFICANTLY GREATER WEIGHT GAIN[1]



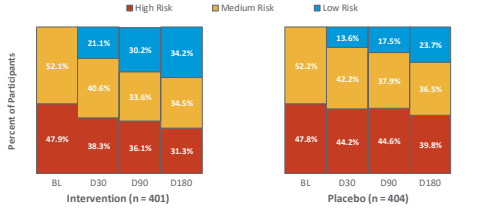
Weight loss in older adults is associated with increased morbidity and mortality[2-3]

1. Chew STH, et al. *Clin Nutr*. 2021;40(4):1879-1892.
2. Haugaajard TR, et al. *J Nutr Health Aging*. 2017;21(8):909-917.
3. Chapman IM. *Med Clin North Am*. 2011;95(3):579-593.

95

INTERVENTION GROUP 3X MORE LIKELY TO HAVE LOWER NUTRITIONAL RISK

Odds of having lower nutritional risk (MUST) = 2.68; P<0.001
Odds Ratio: Day 30 = 2.29, Day 90 = 3.35, Day 180 = 2.50; all P<0.001

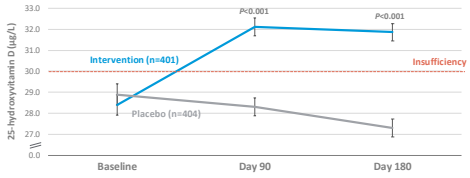


ANHI Chew STH, et al. *Clin Nutr*. 2021;40(4):1879-1892.

BL- Baseline
D- Day

96

INTERVENTION GROUP HAD SIGNIFICANTLY HIGHER 25-HYDROXYVITAMIN D LEVELS[1]



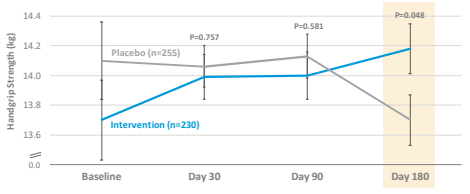
Two servings of ONS provide 620 IU of vitamin D, which is 78% of the Recommended Dietary Allowance for adults aged >70 years[2]

1. Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892.
2. Holick MF. *N Engl J Med.* 2007;357(3):266-281.

IU- International Units

97

FEMALES IN INTERVENTION GROUP HAD SIGNIFICANTLY HIGHER HANDGRIP STRENGTH AT DAY 180[1]

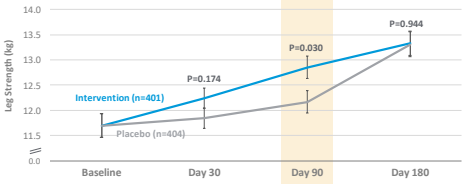


Low grip strength is a powerful predictor of poor patient outcomes eg; longer hospital stay, increased functional limitations, poor health-related quality of life and mortality[2-3]

1. Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892.
2. Ibrahim K, et al. *Pilot Feasibility Stud.* 2016:2:27.
3. Leong DP, et al. *The Lancet.* 2015;386:266-273.

98

INTERVENTION GROUP HAD SIGNIFICANTLY HIGHER LEG STRENGTH AT DAY 90[1]

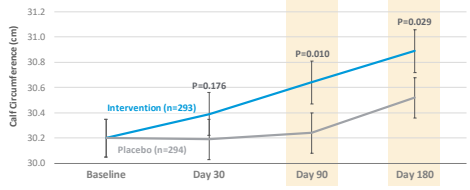


Low lower limb strength is associated with increased risk of disability, recurrent falls, hip fractures, increased hospitalization and mortality in the older adults[2-3]

1. Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892.
2. Lang T, et al. *Osteoporos Int.* 2010;21:543-559.
3. Newman AB, et al. *J Gerontol A Biol Sci Med Sci.* 2006;61:72-77.

99

INTERVENTION GROUP HAD SIGNIFICANTLY GREATER CALF CIRCUMFERENCE AT DAYS 90 AND 180 AMONG THOSE WITH LOW ASMI[1]



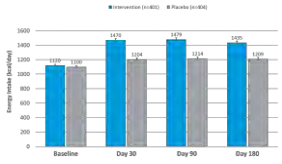
Calf circumference is a known surrogate marker of lean muscle mass, which is related to multiple health outcomes and it can be used to screen for sarcopenia[2-5]

1. Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892; 2. Maeda K, et al. *Ann Nutr Metab.* 2017;71(1-2):10-5; 3. Kawakami R, et al. *Geriatr Gerontol Int.* 2015;15(8):969-76; 4. Prado CM, et al. *Ann Med.* 2018;50(8):675-93; 5. Chen L-K, et al. *J Am Med Dir Assoc.* 2020;21(3):300-7.e2.

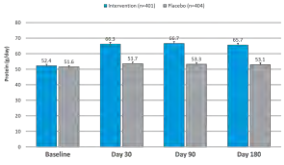
100

SHIELD DIETARY DATA– TOTAL ENERGY AND PROTEIN INTAKE PER DAY

TOTAL ENERGY INTAKE PER DAY



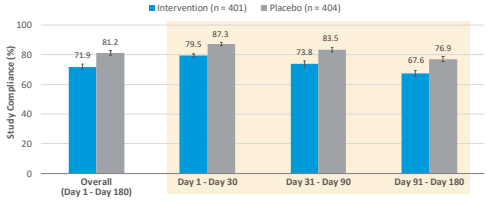
TOTAL PROTEIN INTAKE PER DAY



Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892.

101

COMPLIANCE TO STUDY PRODUCTS WAS RELATIVELY HIGH



Contrary to the widely perceived idea that Asian older persons are averse to milk-based nutritional supplements

Chew STH, et al. *Clin Nutr.* 2021;40(4):1879-1892.

102

INTEGRATED RET AND NUTRITIONAL INTERVENTION

- Integrated interventions significantly better than nutrition alone
  - European and Asian cohorts[1-3]
  - Including very old[4]
- Muscle strength, muscle mass and function
- Strong effect preventing age related loss of muscle mass and strength
- Recommended by ICFSR 2018 and ESPEN 2019[5,6]
  - Treatment for sarcopenia
  - Improve muscle health in older adults at risk or with malnutrition

ESPEN- European Society for Clinical Nutrition and Metabolism
ICFSR- International Conference on Frailty & Sarcopenia Research

1. Yamada M, et al. *Geriatr Gerontol Int.* 2019;19(5):429-437; 2. Liao CD, et al. *Am J Clin Nutr.* 2017;106(4):1078-1091; 3. Antoniak AE, et al. *BMJ Open.* 2017;7(7):e014419; 4. Fiatarone MA, et al. *N Engl J Med.* 1994;330(25):1769-1775; 5. Dent E, et al. *J Nutr Health Aging.* 2018;22(10):1148-1161; 6. Volkert D, et al. *Clin Nutr.* 2019;38(1):10-47

103

SUMMARY

- Malnutrition, sarcopenia and frailty intimately linked
- Malnutrition key target for early identification and intervention
- Progressive resistance exercise training is first line in the treatment and prevention of sarcopenia
- Adequate energy, protein, vitamin D important for muscle health
- Targeted oral nutritional supplementation with HMB effective at-risk community dwelling older adults
- Paradigm change of maintaining and protecting function and muscle health with aging instead of living with frailty and disability in old age

104

FROM WAITING TO FRAIL (FAIL), TO LIVING STRONG

Chen Jifang, 68-year-old grandmother from Shanghai, 2020

105

SHIELD STUDY TEAM 2017

106

THANK YOU

107

INNOVATION: THE FUTURE OF NUTRITION INTERVENTION TO ADDRESS MALNUTRITION/MUSCLE LOSS

PROF. DR. PHILIP J ATHERTON, PHD, AFHEA
CHAIR OF CLINICAL, METABOLIC, AND MOLECULAR PHYSIOLOGY SCHOOL OF MEDICINE
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITY OF NOTTINGHAM, DERBY, UK

108

DISCLOSURE

The content of this program has met the (continuing education) criteria of being evidence-based, fair and balanced, and non-promotional

This educational event is supported by Abbott Nutrition Health Institute, Abbott Nutrition

Disclosures for **Prof. Dr. Philip J. Atherton** include:

- Receipt of research funding and consultation/speaker fees for Abbott Nutrition and Fresenius Kabi

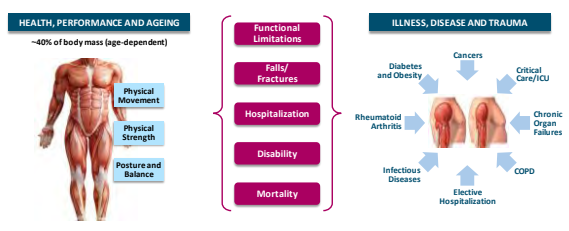
109

OBJECTIVES

1. Summarize available evidence on mechanisms that lead to loss of muscle mass, strength and physical function
2. Review data on existing interventions and novel nutrients/ingredients under investigation to support strength and physical function
3. Describe potential implications of nutrition interventions for public health programs and messages to support healthy ageing

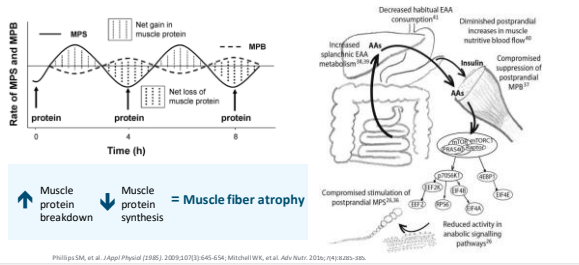
110

SKELETAL MUSCLE: CENTRAL ROLE IN MOBILITY



111

METABOLIC ASPECTS: MUSCLE WASTING ("ANABOLIC RESISTANCE")



Phillips SM, et al. *J Appl Physiol (1985).* 2009;107(3):645-654; Mitchell WK, et al. *Adv Nutr.* 2016;7(4):828S-38S.

AA- Amino Acid; EAA- Essential Amino Acid; EEF2- Eukaryotic Elongation Factor 2; EEF2K- Eukaryotic Elongation Factor 2 Kinase; EIF- Eukaryotic Initiation Factor; MPB- Muscle Protein Breakdown; MPS- Muscle Protein Synthesis; mTOR- Mechanistic Target of Rapamycin; mTORC1- Mechanistic Target of Rapamycin Complex 1; 4EBP1- Eukaryotic Initiation Factor 4E-Binding Protein 1; RPS6- Ribosomal Protein S6; 4EBP1 4E-Binding Protein

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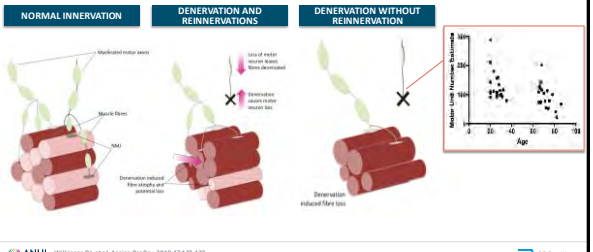
112

NEUROMUSCULAR ASPECTS: MUSCLE WASTING



Wilkinson DJ, et al. *Ageing Res Rev.* 2018;47:123-132.
Piasecki M, et al. *J Physiol.* 2016;594(16):4525-4536.

NMJ- Neuromuscular Junction

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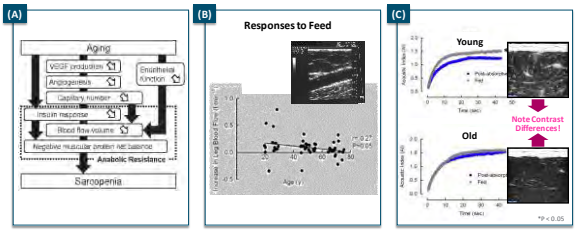
113

MICROVASCULAR ASPECTS: MUSCLE WASTING



Zempo H, et al. *J Phys Fitness Sports Med.* 2017; 6(1):25-31.
Phillips B, et al. *J Appl Physiol (1985).* 2012;112(3):347-353.

VEGF- Vascular Endothelial Growth Factor

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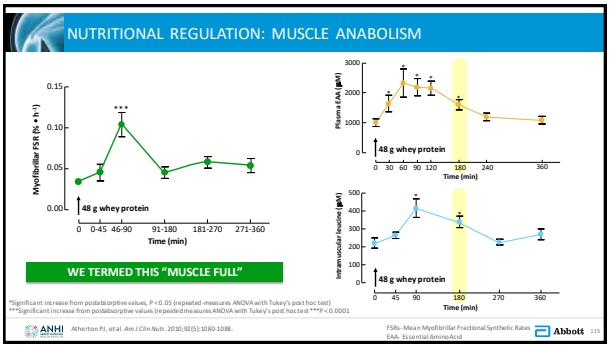
114


NUTRITIONAL REGULATION: MUSCLE ANABOLISM
Myofibrillar FSR (% • h⁻¹)
48 g whey protein
Time (min)
WE TERMED THIS "MUSCLE FULL"
Plasma EAA (μM)
Intramuscular leucine (μM)
*Significant increase from postabsorptive values, P < 0.05 (repeated-measures ANOVA with Tukey's post hoc test)
***Significant increase from postabsorptive values (repeated-measures ANOVA with Tukey's post hoc test ***P < 0.0001
Atherton PJ, et al. Am J Clin Nutr. 2010;92(5):1080-1088.
FSRs- Mean Myofibrillar Fractional Synthetic Rates
EAA- Essential Amino Acid
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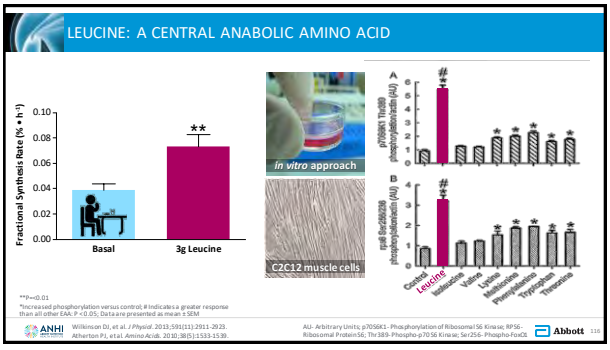
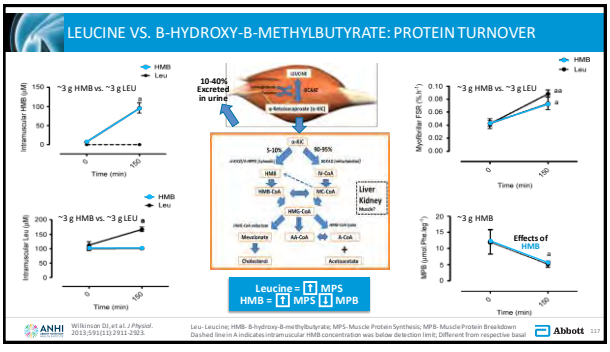
115


LEUCINE: A CENTRAL ANABOLIC AMINO ACID
Fractional Synthesis Rate (% • h⁻¹)
Basal
3g Leucine
in vitro approach
C2C12 muscle cells
Control
Leucine
Isoleucine
Valine
Lysine
Methionine
Phenylalanine
Tryptophan
Threonine
**P=<0.01
*Increased phosphorylation versus control; # Indicates a greater response than all other EAA; P <0.05; Data are presented as mean ± SEM
Wilkinson DJ, et al. J Physiol. 2013;591(11):2911-2923.
Atherton PJ, et al. Amino Acids. 2010;38(5):1533-1539.
AU- Arbitrary Units; p70S6K1- Phosphorylation of Ribosomal S6 Kinase; RPS6- Ribosomal Protein S6; Thr 389- Phospho-p70 S6 Kinase; Ser256- Phospho-FoxO1
Abbott

116


LEUCINE VS. Β-HYDROXY-Β-METHYLBUTYRATE: PROTEIN TURNOVER
HMB
Leu
~3 g HMB vs. ~3 g LEU
Time (min)
10-40% Excreted in urine
5-10%
90-95%
Liver
Kidney
Muscle
Leucine = ↑ MPS
HMB = ↑ MPS ↓ MPB
Effects of HMB
Leu- Leucine; HMB- B-hydroxy-B-methylbutyrate; MPS- Muscle Protein Synthesis; MPB- Muscle Protein Breakdown
Dashed line in A indicates intramuscular HMB concentration was below detection limit; Different from respective basal
Wilkinson DJ, et al. J Physiol. 2013;591(11):2911-2923.
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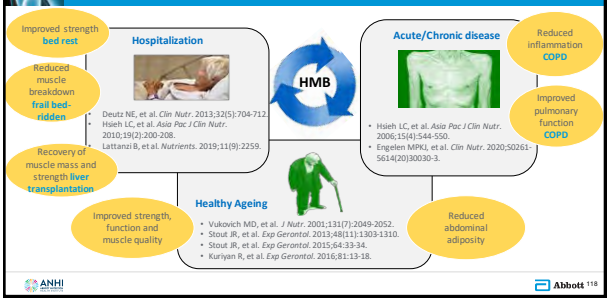
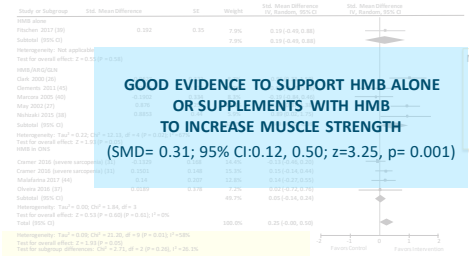
117

CLINICAL EVIDENCE OF HMB ALONE IN OLDER ADULTS ACROSS CONTINUUM OF CARE



118

HMB SUPPLEMENTS: EFFECTS ON MUSCLE



GOOD EVIDENCE TO SUPPORT HMB ALONE OR SUPPLEMENTS WITH HMB TO INCREASE MUSCLE STRENGTH

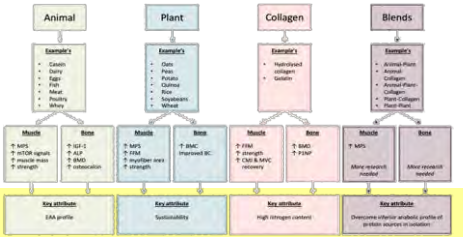
(SMD= 0.31; 95% CI:0.12, 0.50; z=3.25, p= 0.001)

Meta-analysis includes 15 randomized controlled trials using HMB alone, HMB + amino acids or HMB + ONS (N=2137)

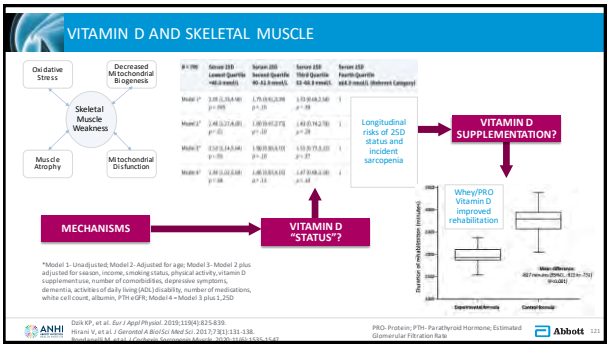
119

PROTEIN SOURCES: EFFECTS ON *MUSCULOSKELETAL* OUTCOMES

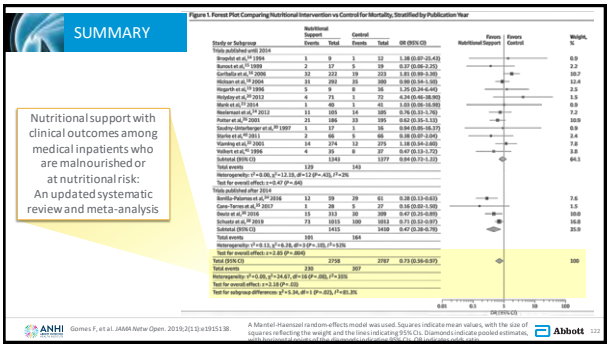
CONSIDERATIONS:
- Digestibility?
- Protein "quality"?
- Matrix effects?
- Bio-actives?



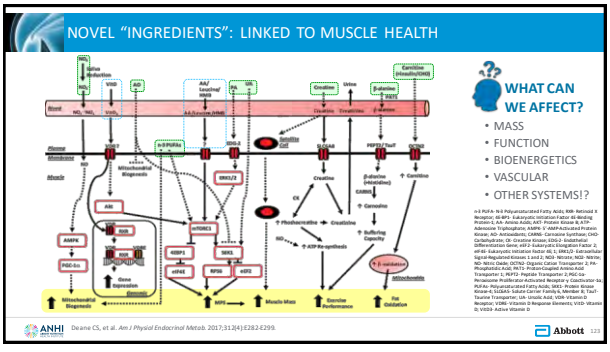
120


VITAMIN D AND SKELETAL MUSCLE
Oxidative Stress
Decreased Mitochondrial Biogenesis
Skeletal Muscle Weakness
Muscle Atrophy
Mitochondrial Disfunction
Longitudinal risks of 25D status and incident sarcopenia
VITAMIN D SUPPLEMENTATION?
Whey/PRO Vitamin D improved rehabilitation
MECHANISMS
VITAMIN D "STATUS"?
*Model 1- Unadjusted; Model 2- Adjusted for age; Model 3 - Model 2 plus adjusted for season, income, smoking status, physical activity, vitamin D supplementuse, number of comorbidities, depressive symptoms, dementia, activities of daily living (ADL) disability, number of medications, white cell count, albumin, PTH eGFR; Model 4 = Model 3 plus 1_25D
Dzik KP, et al. Eur J Appl Physiol. 2019;119(4):825-839.
Hirani V, et al. J Gerontol A Biol Sci Med Sci. 2017;72(1):131-138.
PRO- Protein; PTH- Parathyroid Hormone; Estimated Glomerular Filtration Rate
Abbott
121

121


SUMMARY
Nutritional support with clinical outcomes among medical inpatients who are malnourished or at nutritional risk: An updated systematic review and meta-analysis
Figure 1. Forest Plot Comparing Nutritional Intervention vs Control for Mortality, Stratified by Publication Year
Gomes F, et al. JAMA Netw Open. 2019;2(11):e191538.
A Mantel-Haenszel random-effects model was used. Squares indicate mean values, with the size of squares reflecting the weight and the lines indicating 95% CIs. Diamonds indicate pooled estimates,
Abbott
122

122


NOVEL "INGREDIENTS": LINKED TO MUSCLE HEALTH
WHAT CAN WE AFFECT?
• MASS
• FUNCTION
• BIOENERGETICS
• VASCULAR
• OTHER SYSTEMS!?
Deane CS, et al. Am J Physiol Endocrinol Metab. 2017;312(4):E282-E299.
Abbott
123

123

CONCLUSIONS

MUSCLE IS CRITICAL IN HEALTH/ILLNESS	• Central role in strength and mobility, critical role in metabolism • Muscle dysfunction/atrophy involved in myriad non-infectious and infectious diseases • Poor muscle health and/or outcomes linked to increased risk of morbidity and mortality
MECHANISMS LEADING TO MUSCLE DYSFUNCTION	• Dysregulated muscle protein turnover ("anabolic resistance") = fibre atrophy • Motor neuron loss = fibre loss • Reduced macro/micro-vasculature and mitochondrial function = bioenergetic failure
ESTABLISHED NUTRITIONAL AVENUES TO MITIGATE MUSCLE LOSS/DYSFUNCTION	• Protein-based = e.g., distinct sources, "quality", quantity and leucine content to consider • HMB as a leucine metabolite that increases MPS/decreases MPB • Vitamin D, where deficiency is linked to muscle atrophy/dysfunction/sarcopenia
NOVEL INGREDIENTS/ INTERVENTIONS TO IMPROVE MUSCLE HEALTH OUTCOMES	• Omega-3/anti-oxidants (myriad), nitrates (vascular), β-alanine/carnitine/creatine (bioenergetics) • Maximizing anabolic *efficiency*: food matrix, protein timing and diurnal distribution • Understanding specific patient needs and recognition of contractile activity to support outcomes

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124

THANK YOU

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125

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INNOVATION: THE FUTURE OF BODY COMPOSITION TESTING: WHAT CAN BODY COMPOSITION REALLY TELL YOU?

"DISSECTING THE SYSTEMIC CARDIOPULMONARY-METABOLIC PHENOTYPE AT RISK"

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126

126

DISCLOSURES

The content of this program has met the (continuing education) criteria of being evidence-based, fair and balanced, and non-promotional

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Disclosures for **JEROEN MOLINGER, MSc** include:

- Research funding from MuscleSound
- Honoria for speaking engagement from Abbott

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127

OBJECTIVES

1. Review current body composition testing techniques for use in research vs. clinical practice
2. Describe current ultrasound technology for measuring muscle mass
3. Examine new (ultrasound) technologies for testing body composition

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128

BODY COMPOSITION vs. "BEING FIT" vs. "BEING AT RISK"?

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129

KEY NOTES: BODY COMPOSITION

"BC; What you see is not always what you get"

A (new) metric of systemic mitochondrial (dys)function; beyond assessing kg/lbs only

130

WHAT YOU SEE IS NOT ALWAYS WHAT YOU GET (WYSINAWYG)

131

MUSCLE MASS MATTERS; BUT DOES MORE MASS MATTER MORE?

132

BODY COMPOSITION <-> WYSINAWYG ??

WHY is body composition correlated to outcome?

HOW is body composition correlated to outcome?

WHAT is most correlated to outcome (mortality)?

133

PREDICTOR ALL-CAUSE MORTALITY; CARDIORESPIRATORY FITNESS

VO_2max ↑1 MET: (3,5 ml/min/kg).

✓13% ↓ Mortality

Meaning Cardiorespiratory fitness is a modifiable indicator of long-term mortality, and health care professionals should encourage patients to achieve and maintain high levels of fitness.

CONCLUSIONS CRF was significantly related to longevity over the course of 4 decades in middle-aged, employed men free of CVD. The benefits of higher midlife CRF extend well into the later part of life. (J Am Coll Cardiol 2018;72:987–95)

134

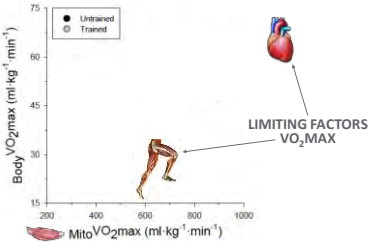
DEFINING CARDIORESPIRATORY FITNESS

FICK PRINCIPLE

VO_2max = **Cardiac-Output**  X **O_2 Consumption Muscles** 

135

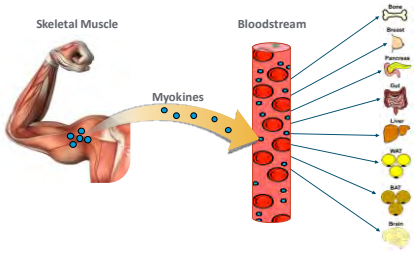
AEROBIC CAPACITY: VO_2MAX



ANHI Gifford JR, et al. *J Physiol.* 2016;594(6):1741-1751. Mito- Mitochondria Abbott 136

136

MUSCLE TALK: MYOKINES

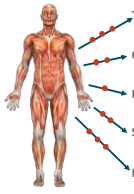


ANHI Schnyder S, et al. *Bone.* 2015;80:115-125. WAT- White Adipose Tissue BAT- Brown Adipose Tissue Abbott 137

137

MUSCLE REGULATES METABOLISM

Malnourished State



- Tissue Structure & Function
- Organ Structure & Function
- Immune Responses
- Skin Integrity
- Neural Function

Skeletal Muscle

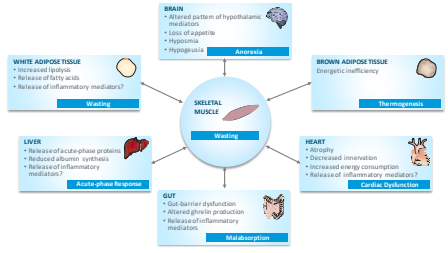
Skeletal Muscle Regulates Metabolism via Interorgan Crosstalk: Roles in Health and Disease

Josep M Argilés, PhD; Nefertiti Campos, PhD; José M Lopez-Pedrosa, PhD; Ricardo Rueda, MD, PhD; Leocadio Rodriguez-Mañas, PhD

ANHI Argilés JM, et al. *J Am Med Dir Assoc.* 2016;17(9):789-796. Abbott 138

138

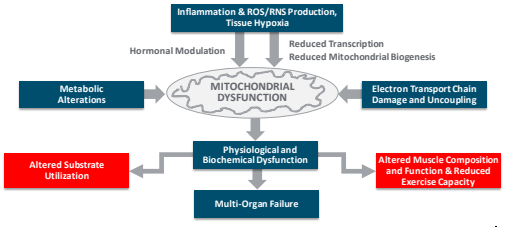
INTERORGAN CROSSTALK; MUSCLE TALK



ANHI Argilés JM, et al. *Nat Rev Cancer*. 2014;14(11):754-762. Abbott 139

139

MUSCLE AS A PROXY OF ALTERED SUBSTRATE UTILIZATION



ANHI Molinger J, et al. *Curr Opin Crit Care*. 2020;26(4):368-378.

ROS- Reactive Oxygen Species
RNS- Reactive Nitrogen Species

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140

MUSCLE AS A PROXY OF ALTERED SUBSTRATE UTILIZATION

Critical care

ORIGINAL ARTICLE

Metabolic phenotype of skeletal muscle in early critical illness

Puthucheary ZA, Astin R, Mcphail MJW, Saeed S, Pasha Y, Bear DE, Constantin D, Velloso C, et al.

"Intramuscular inflammation is associated with impaired anabolic recovery with lipid delivery observed as bioenergetically inert"

"Intramuscular lipid accumulation results in a dysregulated lipid oxidation"

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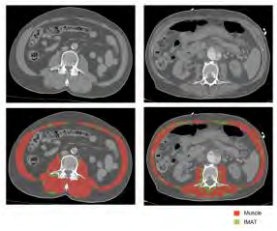
141

MUSCLE AS A PROXY OF ALTERED SUBSTRATE UTILIZATION



Skeletal muscle quality as assessed by CT-derived skeletal muscle density is associated with 6-month mortality in mechanically ventilated critically ill patients

ANHI Looijaard WG, et al. *Crit Care*. 2016;20(1):386.

CT- Computed Tomography
IMAT- Intermuscular Adipose Tissue

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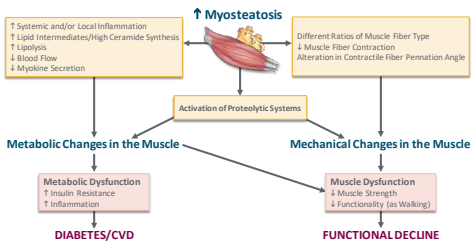
142

MUSCLE AS A PROXY OF ALTERED SUBSTRATE UTILIZATION



ANHI Correa-de-Araujo R, et al. *Front Physiol*. 2017;8:87.

CVD- Cardiovascular Disease

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143

MUSCLE AS A PROXY OF ALTERED CARDIORESPIRATORY FITNESS

ORIGINAL ARTICLE

Myosteatosis is associated with poor physical fitness in patients undergoing hepatopancreatobiliary surgery

ORIGINAL ARTICLE

Myosteatosis to predict inferior perioperative outcome in patients undergoing orthotopic liver transplantation

Zoltan Czigany | Wiebke Kramp | Jan Bednarsch | Gregory van der Kroft | Joerg Boecker | Pawel Strnad | Markus Zimmermann | Ger Koek | Ulf Peter Neumann | Georg Lurje

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144

MUSCLE ULTRASOUND; PROXY FOR MUSCLE STRENGTH

Echo intensity is associated with skeletal muscle power and cardiovascular performance in elderly men

Muscle mass and intramuscular fat of the quadriceps are related to muscle strength in non-ambulatory chronic stroke survivors: A cross-sectional study

Skeletal muscle quality assessed from echo intensity is associated with muscle strength of middle-aged and elderly persons

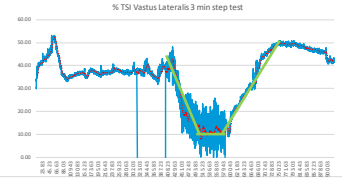
Regional and total muscle mass, muscle strength and physical performance: The potential use of ultrasound imaging for sarcopenia

Ayşe Merve Ata, Murat Kara, Bayram Kaymak, Eda Gürçay, Banu Çakır, Hande Ünlü, Aygen Akıncı, Levent Özçakar

Cadore EL, et al. *Exp Gerontol*. 2012;47(6):473-478; Akazawa N, et al. *PLoS One*. 2018;13(8):e0201789; Fukumoto Y, et al. *Eur J Appl Physiol*. 2012;112(4):1519-25; Ata AM, et al. *Arch Gerontol Geriatr*. 2019;83:55-60.

MUSCLE NEAR INFRARED SPECTROSCOPY (NIRS); PROXY FOR MUSCLE FUNCTION

In vivo assessment of muscle mitochondrial function in healthy, young males in relation to parameters of aerobic fitness



Lagerwaard B, et al. *Eur J Appl Physiol*. 2019;119(8):1799-1808.

TSI- Tissue Oxygen Saturation Index

MUSCLESOUND; ECHO-INTENSITY ANALYSES

Validation of Musculoskeletal Ultrasound to Assess and Quantify Muscle Glycogen Content. A Novel Approach

John C. Hill, DO, FAAFP, FACSM; Iñigo San Millán, PhD

RESEARCH ARTICLE Open Access

Ultrasonic assessment of exercise-induced change in skeletal muscle glycogen content

MEASUREMENT OF INTRAMUSCULAR FAT BY MUSCLE ECHO INTENSITY

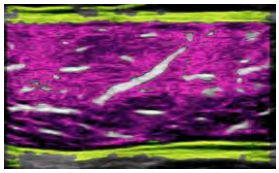
HUI-JU YOUNG, PhD,[1] NATHAN T. JENKINS, PhD,[1] QUN ZHAO, PhD,[2] and KEVIN K. MCCULLY, PhD[1]

[1]Department of Kinesiology, University of Georgia, Athens, Georgia, USA
[2]Department of Physics and Biomaging Research Center, University of Georgia, Athens, Georgia, USA

Accepted 11 March 2013

Hill JC, et al. *Phys Sportsmed*. 2014;42(3):45-52.
Nieman DC, et al. *BMC Sports Sci Med Rehabil*. 2015;7:9.

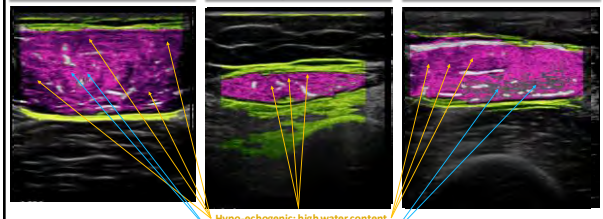
MSK ULTRASOUND – METABOLIC IMAGING



148

MUSCLESOUND RECTUS FEMORIS MUSCLE

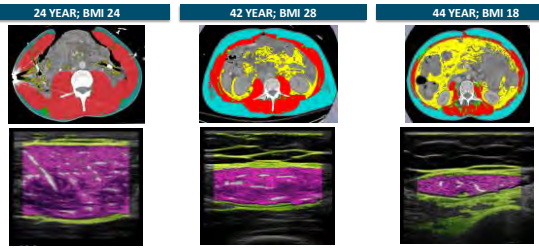
HEALTHY CONTROL	FRAILTY/SARCOPENIA	SEPSIS DAY 5



149

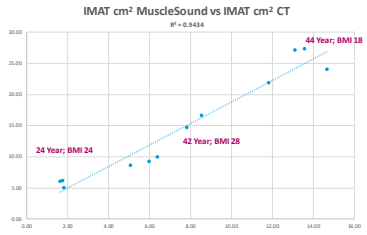
MUSCLE METABOLIC IMAGING; CT VERSUS US

24 YEAR; BMI 24	42 YEAR; BMI 28	44 YEAR; BMI 18



150

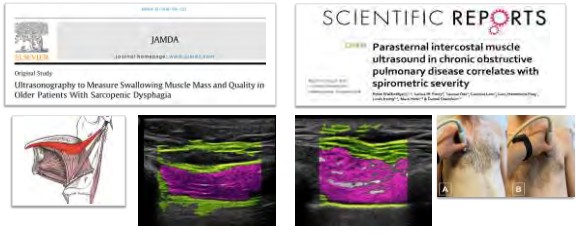
MUSCLE METABOLIC IMAGING; CT VERSUS US



AMMPUS Study Duke, (unpublished data, June 2021).

151

MUSCLE METABOLIC IMAGING; MUSCLE(S) OF INTEREST



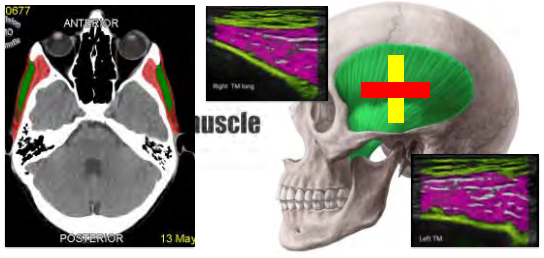
Ogawa N, et al. *J Am Med Dir Assoc.* 2018;19(6):516-522.
Wallbridge P, et al. *Sci Rep.* 2018;8(1):154.

152

MUSCLE METABOLIC IMAGING; MUSCLE(S) OF INTEREST

153

MUSCLE METABOLIC IMAGING; MUSCLE(S) OF INTEREST



AMMPUS Study Duke, (unpublished data, June 2021).

TM- Temporalis Muscle

154

154

SUMMARY

- What you see is not always what you get; there is a need to address body composition (BC)
- Muscle histology is a proxy of muscle strength and endurance
- Body composition, muscle histology and muscle metabolic profile are very much connected
- The imaging modality MSK ultrasound is able to assess BC in relation to muscle mass, intramuscular adipose fat (IMAT) / (muscle quality)

MSK- Musculoskeletal

155

155

THANK YOU

156

156