

Restricted, Sensitive (Normal)

# FM ACP RESEARCH GRAND ROUND

## Evidence-based Nutritional Interventions to Support Muscle Health

Dr Charles LEW

Principal Dietitian, Ng Teng Fong General Hospital

Chew et al. BMC Geriatrics (2021) 21:314  
https://doi.org/10.1186/s12877-021-02240-8

BMC Geriatrics

RESEARCH ARTICLE

Open Access

Singapore multidisciplinary consensus recommendations on muscle health in older adults: assessment and multimodal targeted intervention across the continuum of care

Samuel T. H. Chew<sup>1,2\*</sup>, Geetha Kayambu<sup>3</sup>, Charles Chin Han Lew<sup>4</sup>, Tze Pin Ng<sup>5</sup>, Fargyi Ong<sup>6</sup>, Jonathan Tan<sup>6</sup>, Ngaiap Chuan Tan<sup>7</sup> and Shuen-Loong Tham<sup>8\*</sup>

Abstract

**Background:** The rapidly aging societies worldwide and in Singapore present a unique challenge, requiring an integrated multidisciplinary approach to address high-value targets such as muscle health. We propose pragmatic evidence-based multidisciplinary consensus recommendations for the assessment and multi-modal management of muscle health in older adults (≥65 years) across the continuum of care.

**Methods:** The recommendations are derived from an in-depth review of published literature by a multidisciplinary working group with clinical experience in the care of the older population in both acute and community settings.

**Results:** The panel recommends screening for muscle impairment using the SARC-2 questionnaire, followed by assessment for low muscle strength (handgrip strength or 5-times chair stand test (212) as a surrogate for lower limb strength) to diagnose possible/probable sarcopenia. For uncomplicated cases, lifestyle modifications in exercise and diet can be initiated in the community setting without further assessment. Where indicated, individuals diagnosed with possible/probable sarcopenia should undergo further assessment.

Diagnosis of sarcopenia should be based on low muscle strength and low muscle mass (bioimpedance analysis, dual-energy X-ray absorptiometry or calf circumference as a surrogate). The severity of sarcopenia should be determined by assessment of physical performance (gait speed or 5-time chair stand test (212) as a surrogate for gait speed). To treat sarcopenia, we recommend a combination of progressive resistance-based exercise training and optimization of nutritional intake (energy, protein and functional ingredients). High quality protein in sufficient quantity, to overcome anabolic resistance in older adults, and distributed throughout the day to enable maximum muscle protein synthesis, is essential. The addition of resistance-based exercise training is synergistic in improving the sensitivity of muscle protein synthesis response to the provision of amino acids and reducing anabolic resistance. An expected dose-response (Continued on next page)

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# Recommendation 9



# R<sub>x</sub>

**Supplementation of protein and calories, either via whole foods and/or high protein oral nutrition supplements, should be the primary focus of any nutrition interventions aimed at optimizing muscle health and recovery in hospitalized patients.**

Chew et al. BMC Geriatrics (2021) 21:184  
https://doi.org/10.1186/s12877-021-02040-8

BMC Geriatrics

RESEARCH ARTICLE Open Access

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Samuel T. H. Chew<sup>1,2\*</sup>, Geetha Kayambu<sup>1</sup>, Charles Chin Han Lew<sup>1</sup>, Tze Pin Ng<sup>1</sup>, Fanyli Ong<sup>1</sup>, Jonathan Tan<sup>1</sup>, Njap Chuan Tan<sup>1</sup> and Shuen-Loong Tham<sup>1,3</sup>

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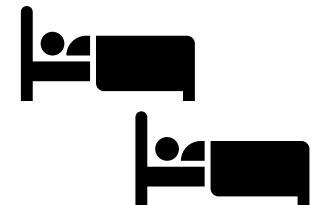
# Higher Protein for Hospitalized



- Older adults with acute or chronic disease require a dietary protein intake of **1.2–1.5 g/kg body weight/day**.<sup>1</sup>



- In severe illness, injury or severe malnutrition, up to **2.0 g protein/kg body weight/day** may be necessary.<sup>1</sup>



1. Bauer J et al. J Am Med Dir Assoc. 2013;14(8):542–59.

# Protein Distribution



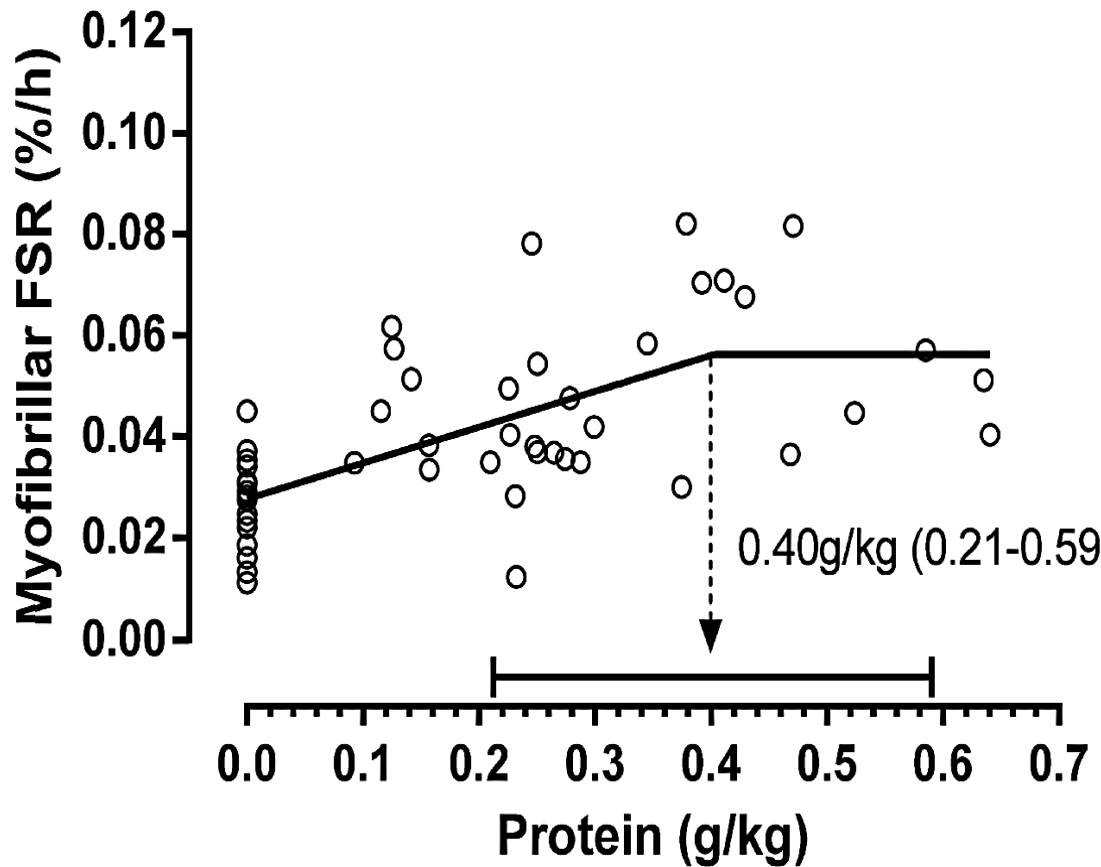
- The **total daily protein** requirement can be **divided evenly across three main meals** to enable some degree of MPS throughout the day.<sup>1-6</sup>



- At least **25–30 g<sup>7</sup> or 0.4g protein/kg<sup>3</sup> per meal** would be required to maximize MPS to account for:
  - increased anabolic resistance
  - periods of energy deficit
  - loss due to first-pass effect during digestion<sup>1, 5, 7</sup>

1. Bauer J et al. J Am Med Dir Assoc. 2013;14(8):542–59
2. Moore DR et al. J Gerontol A Biol Sci Med Sci. 2015;70(1):57–62.
3. Mamerow MM et al. J Nutr. 2014;144(6):876–80.
4. Symons TB et al. J Am Diet Assoc. 2009;109(9):1582–6.
5. Cuthbertson D et al. FASEB J. 2005;19(3):422–4.
6. Paddon-Jones D, van Loon L. In: Sarcopenia: Wiley; 2012. p. 275–95.
7. Stokes T et al. Nutrients. 2018;10(2):180.

# Protein Distribution

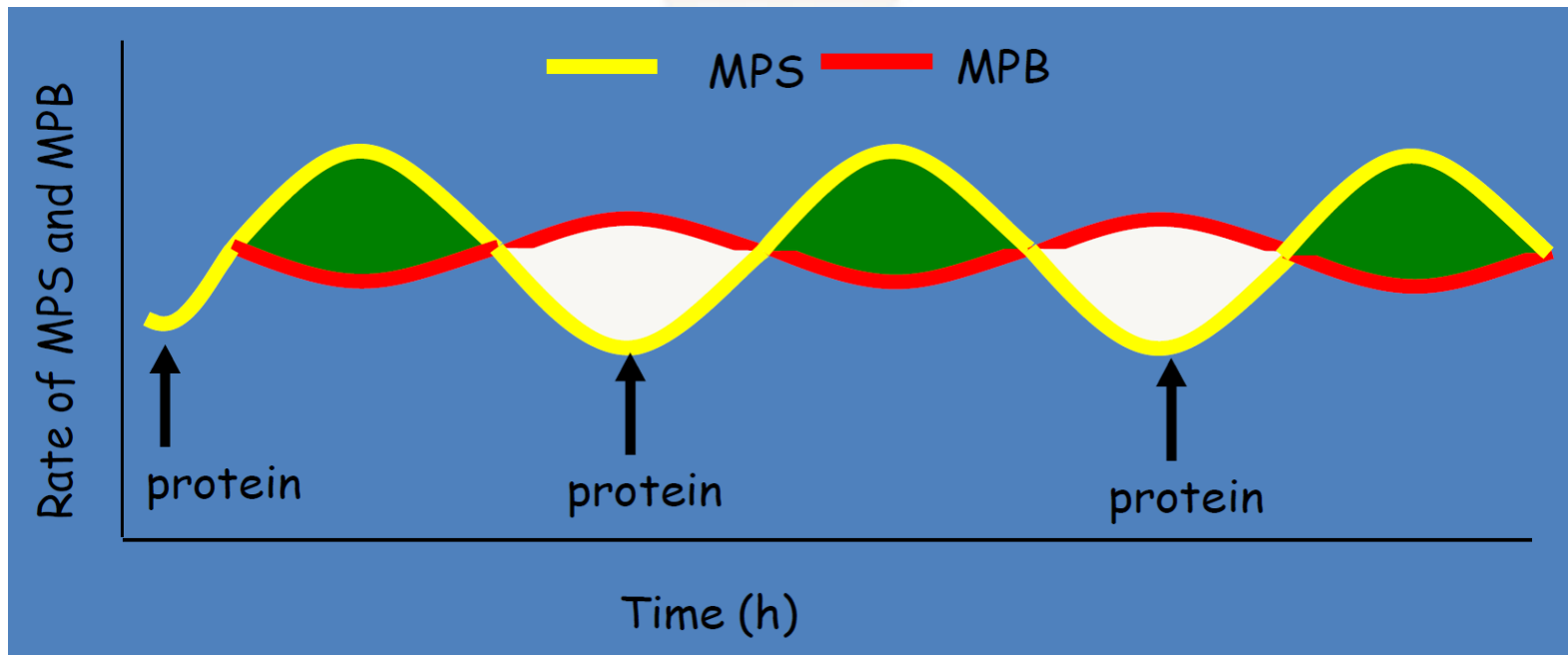


Moore DR et al. J Gerontol A Biol Sci Med Sci. 2015;70(1):57-62

# Net Protein Balance

Synthesis

Breakdown

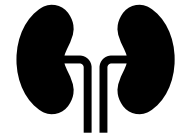


# Protein Balance

## For Kidney Disease



- Older people with severe kidney disease (eGFR < 30mL/min/1.73m<sup>2</sup>) and **not on dialysis may need to limit protein intake.**<sup>1</sup>
- Important to **balance** the avoidance of excess **protein** intake to optimize renal health **versus insufficient protein intake** leading to protein energy wasting.<sup>2</sup>



1. Bauer J et al. J Am Med Dir Assoc. 2013;14(8):542–59.
2. Cano NJ et al. Clin Nutr. 2009;28:401–14.

# ONS For Patients

## At Risk of Functional Decline



- ONS may be offered to hospitalized patients to lower the risk of functional decline.<sup>1</sup>
- If food intake alone is insufficient to meet increased nutritional requirements, additional supplementation may be considered **to improve muscle health** using:
  - HP-ONS + HMB
  - HMB with arginine and glutamine (HMB-Arg-Glut)
  - Leucine

1. Volkert D et al. Clin Nutr. 2019;38(1):10–47.



# HP ONS + HMB



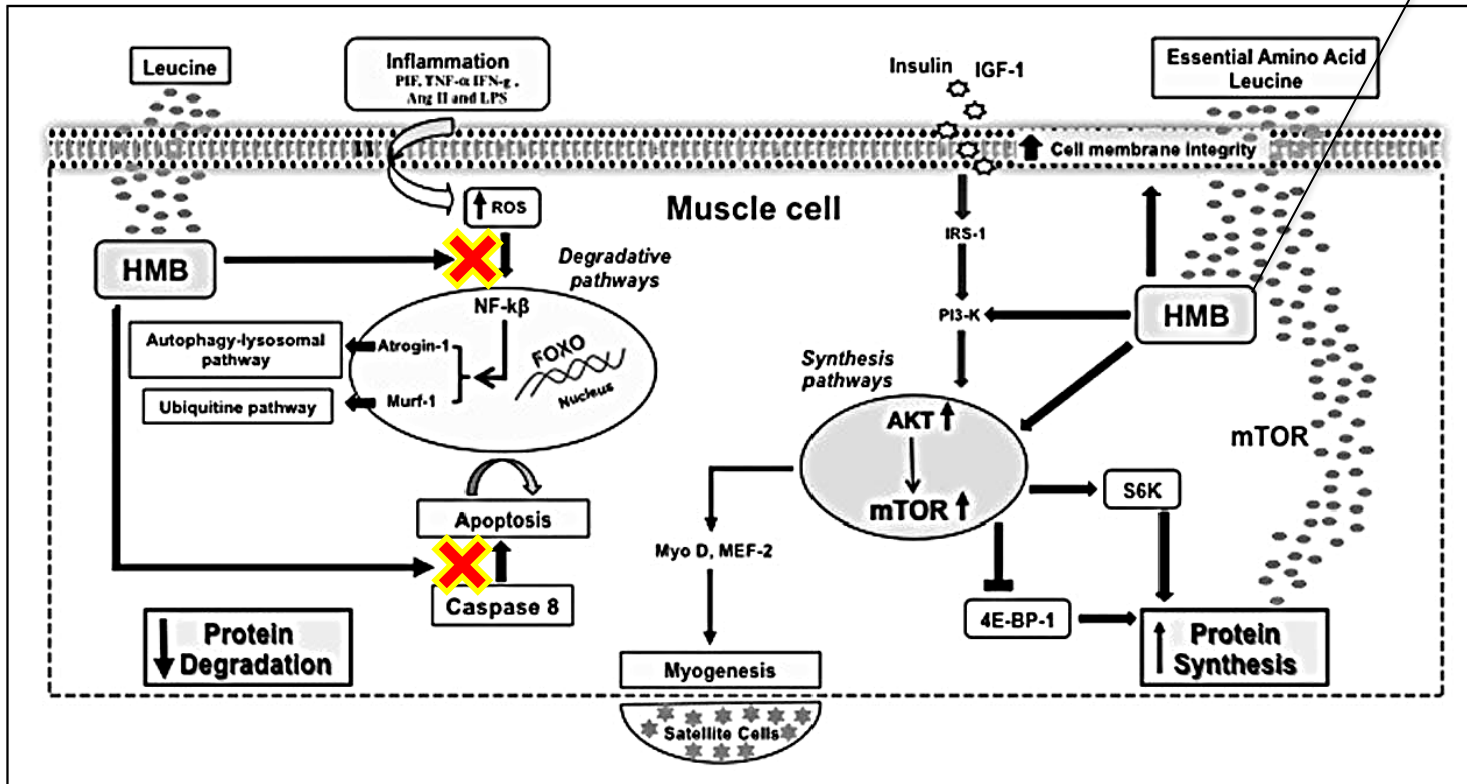
## For Muscle Mass & Strength

- In older patients who are **malnourished or at risk of malnutrition**, limited evidence suggests that **HP-ONS + HMB increases muscle strength<sup>1</sup> and LBM<sup>2</sup>**
  - Meta-analysis demonstrated that leucine supplementation significantly increases LBM and not muscle strength in patients with sarcopenia<sup>3</sup>
  - Some evidence suggests that the use of HMB 2–3 g per day may help prevent muscle mass loss in older adults on prolonged bed rest<sup>4,5</sup>
  - Larger studies are required to confirm these findings.

1. Ekinci O et al. *Nutr Clin Pract*. 2016;31(6):829–35.
2. Malafarina V et al. *Maturitas*. 2017;101:42–50.
3. Komar B et al. *J Nutr Health Aging*. 2015; 19(4):437–46.
4. Deutz NE et al. *Clin Nutr*. 2013;32:704–12.
5. Hsieh LC et al. *Asia Pac J Clin Nutr*. 2010;19(2):200–8.

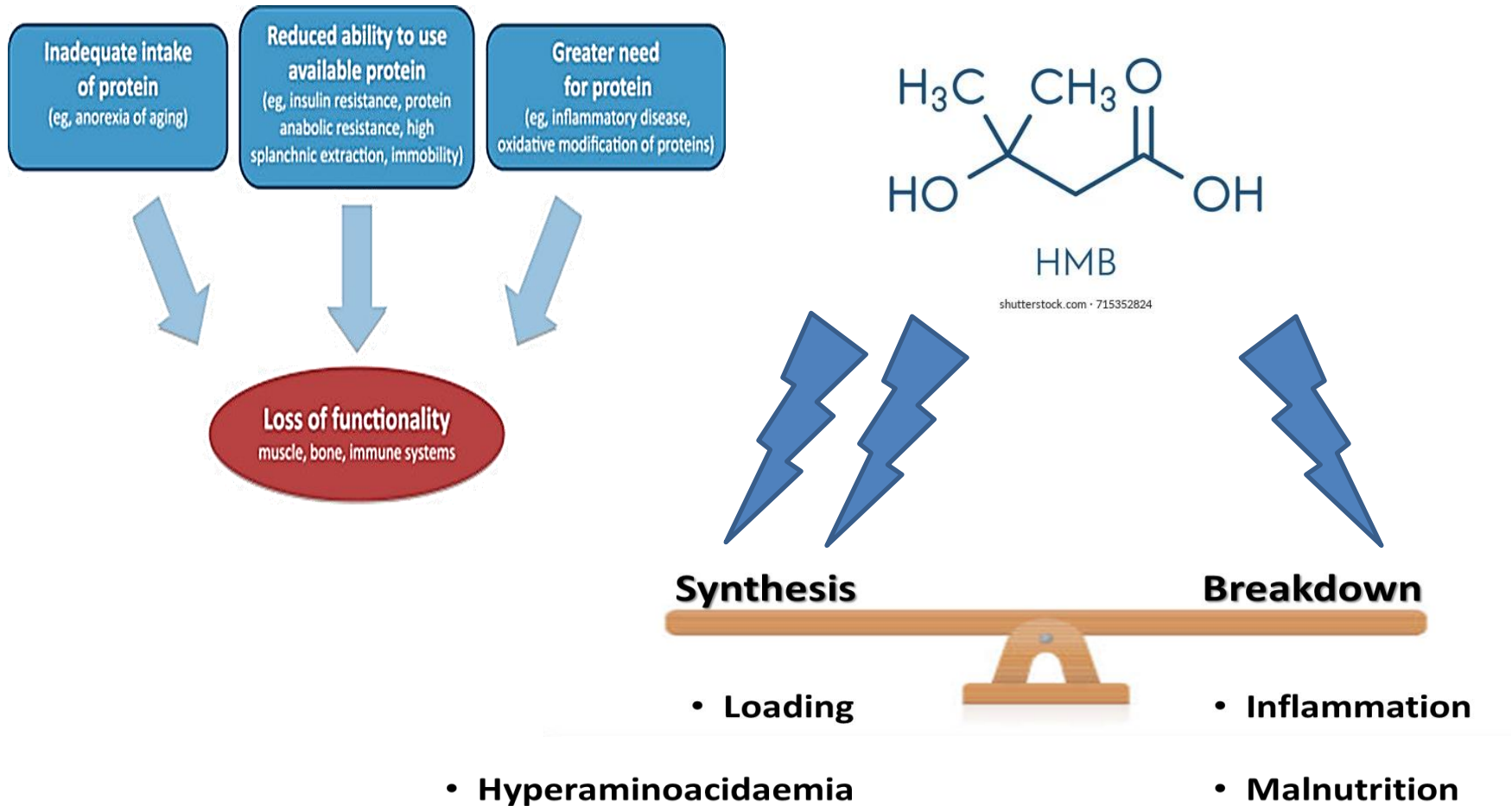
# HMB – in a nutshell

≤ 5%  
(Bung et al. 2018)

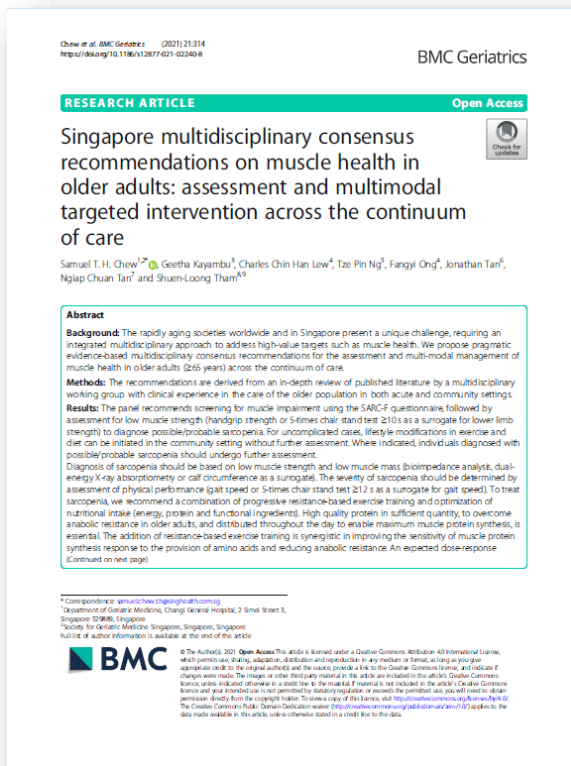


Bung et al (2018) *Proceedings of the National Academy of Sciences*, 115(17), pp.E4071-E4080

# HMB – in a nutshell



# Recommendation 8



**Adequate calorie and protein diet support muscle health for healthy community-dwelling older adults.**

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

Restricted, Sensitive (Normal)





# Treating malnutrition in the general ward saves lives

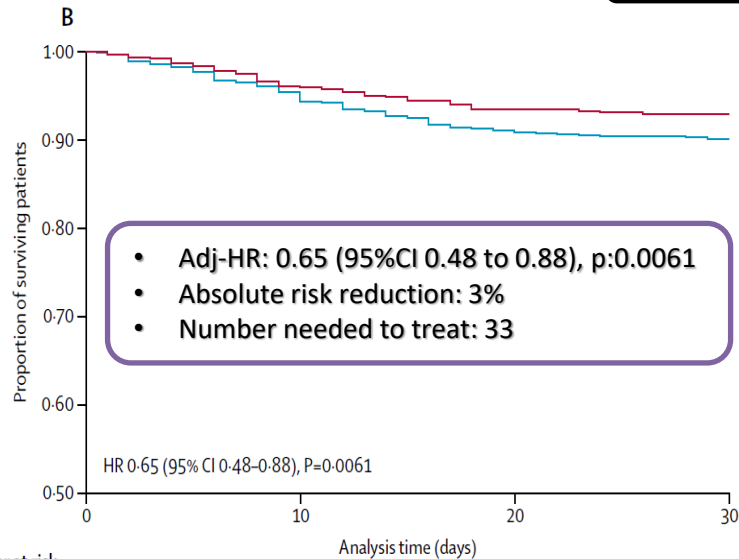


## Individualised nutritional support in medical inpatients at nutritional risk: a randomised clinical trial

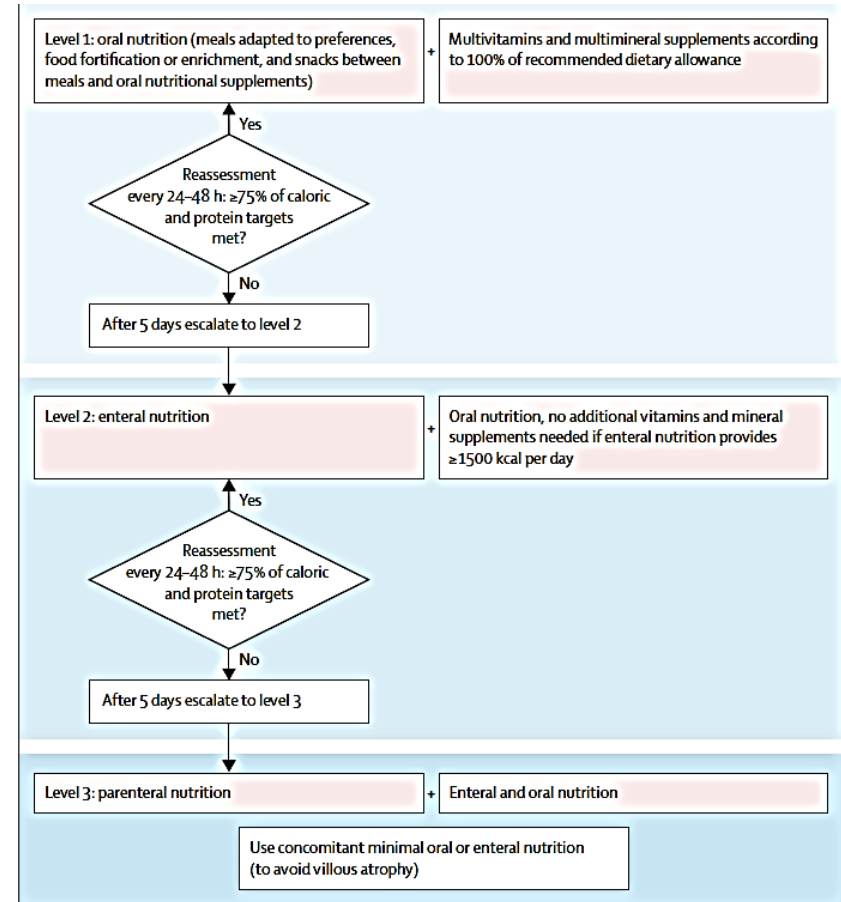


Philipp Schuetz, Rebecca Fehr, Valerie Baechli, Martina Geiser, Manuela Deiss, Filomena Gomes, Alexander Kutz, Pascal Tribolet, Thomas Bregenzer, Nina Braun, Claus Hoess, Vojtech Pavlicek, Sarah Schmid, Stefan Bilz, Sarah Sigrist, Michael Brändle, Carmen Benz, Christoph Henzen, Silvia Mattmann, Robert Thomann, Claudia Brand, Jonas Rutishauser, Drahomir Aujesky, Nicolas Rodondi, Jacques Donzé, Zeno Stanga\*, Beat Mueller\*

n = 2028

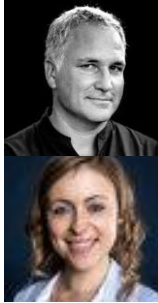


	Analysis time (days)			
Number at risk	0	10	20	30
Control group	1013	967	922	913
Intervention group	1015	975	949	943





# Treating malnutrition in the general ward saves lives



Randomized Control Trials

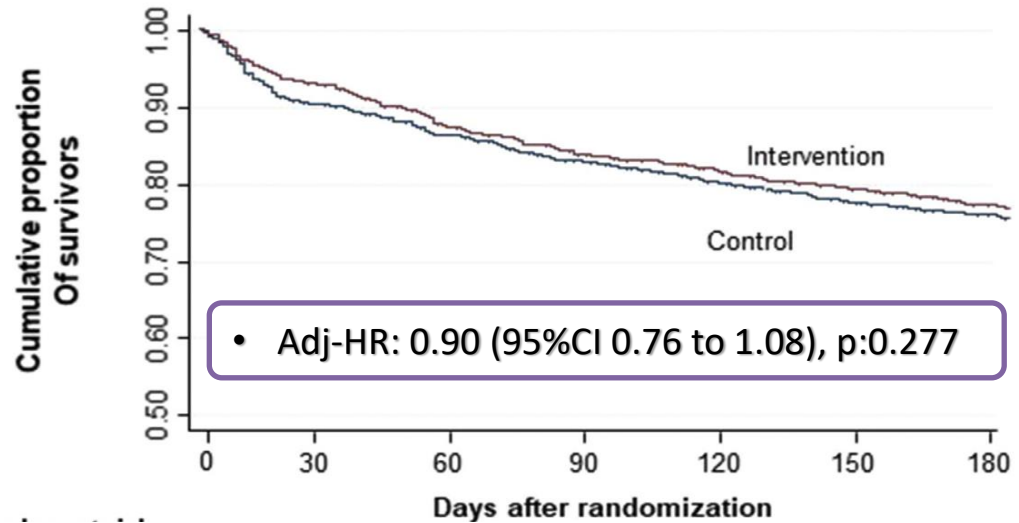
Six-month outcomes after individualized nutritional support during the hospital stay in medical patients at nutritional risk: Secondary analysis of a prospective randomized trial

Nina Kaegi-Braun <sup>a</sup>, Pascal Tribolet <sup>a,b</sup>, Filomena Gomes <sup>a,c</sup>, Rebecca Fehr <sup>a</sup>, Valerie Baechli <sup>a</sup>, Martina Geiser <sup>a</sup>, Manuela Deiss <sup>a</sup>, Alexander Kutz <sup>a</sup>, Thomas Bregenzer <sup>d</sup>, Claus Hoess <sup>e</sup>, Vojtech Pavlicek <sup>e</sup>, Sarah Schmid <sup>e</sup>, Stefan Bilz <sup>f</sup>, Sarah Sigrist <sup>f</sup>, Michael Brändle <sup>f</sup>, Carmen Benz <sup>f</sup>, Christoph Henzen <sup>g</sup>, Silvia Mattmann <sup>g</sup>, Robert Thomann <sup>h</sup>, Jonas Rutishauser <sup>i</sup>, Drahomir Aujesky <sup>i</sup>, Nicolas Rodondi <sup>j,k</sup>, Jacques Donzé <sup>j,l</sup>, Zeno Stanga <sup>m</sup>, Beat Mueller <sup>a,n</sup>, Philipp Schuetz <sup>a,n,\*</sup>

## Similar rates of

- Hospital readmission (27.3% vs. 27.6%)
- Falls (11.2% vs. 10.9%)
- Nutritional support during hospital stay has no legacy effect on longer term outcomes

n = 1993





# Treating malnutrition in the general ward **and hospital discharge** saves lives

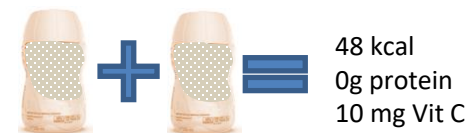
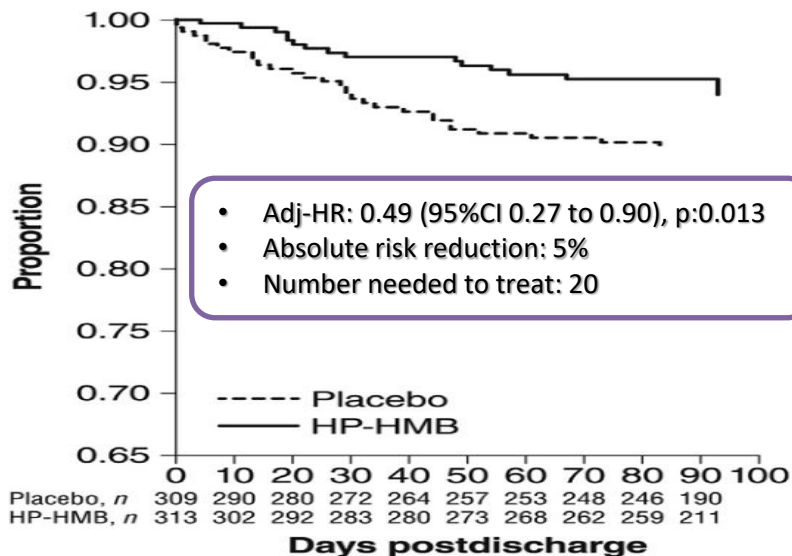


Randomized control trials

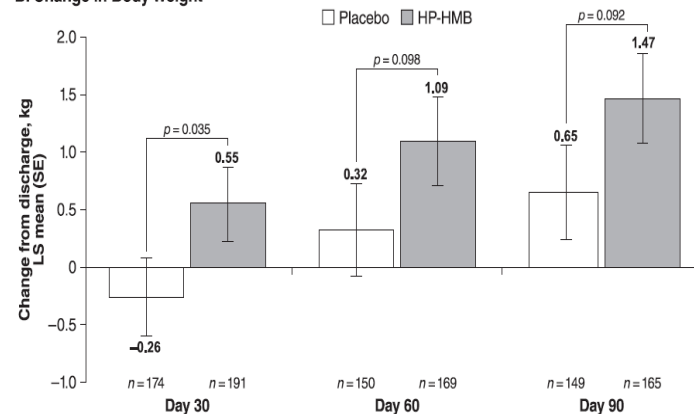
Readmission and mortality in malnourished, older, hospitalized adults treated with a specialized oral nutritional supplement: A randomized clinical trial

Nicolaas E. Deutz<sup>a,\*</sup>, Eric M. Matheson<sup>b</sup>, Laura E. Matarese<sup>c</sup>, Menghua Luo<sup>d</sup>, Geraldine E. Baggs<sup>d</sup>, Jeffrey L. Nelson<sup>d</sup>, Refaat A. Hegazi<sup>d</sup>, Kelly A. Tappenden<sup>e</sup>, Thomas R. Ziegler<sup>f</sup>, on behalf of the NOURISH Study Group

n = 622



B. Change in Body Weight





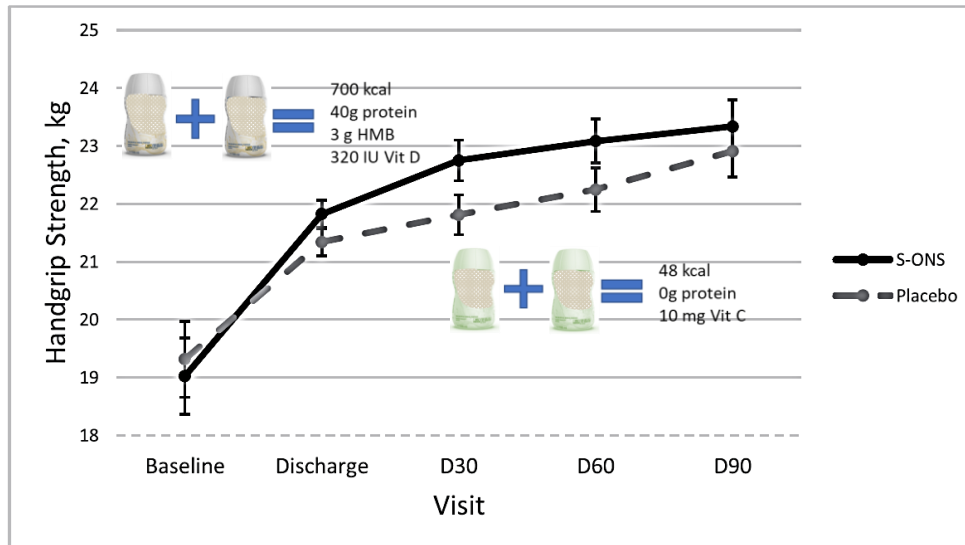
# Treating malnutrition in the general ward **and hospital discharge** saves lives



## Randomized Control Trials

Specialized oral nutritional supplement (ONS) improves handgrip strength in hospitalized, malnourished older patients with cardiovascular and pulmonary disease: A randomized clinical trial

Eric M. Matheson<sup>a</sup>, Jeffrey L. Nelson<sup>b,\*</sup>, Geraldine E. Baggs<sup>b</sup>, Menghua Luo<sup>b</sup>, Nicolaas E. Deutz<sup>c</sup>





# Adequate protein



- A total daily protein intake of **at least 1.0–1.2 g/kg body weight** is recommended in **healthy individuals > 65 years of age**.
- **Recommendations to Practice:**
  - ♂ 70 kg man: 70 – 80 g protein/d (~15 g from carbs, 55-65 from protein foods)
  - ♀ 50 kg woman: 50 – 60 g protein/d (~10 g from carbs, 40-50 from protein foods)

## Examples of 20-25g of protein



# For Exercising Healthy Adults Protein Needs Are Higher

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- In active, **exercising healthy older adults**, protein intake **of  $\geq 1.2$ g/kg body weight/day** is advised.



At least 1.0–1.2 g/kg body weight



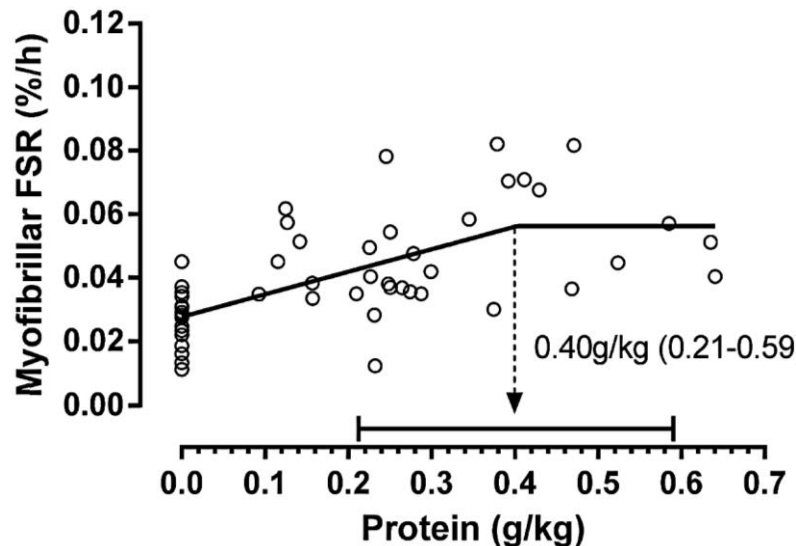
**$\geq 1.2$  g/kg body weight**

Bauer J et al. J Am Med Dir Assoc. 2013;14(8):542–59.

# Protein Distribution Through the Day



- Even distribution of protein intake throughout the day may help ensure some degree of muscle protein synthesis (MPS) throughout the day<sup>1</sup>



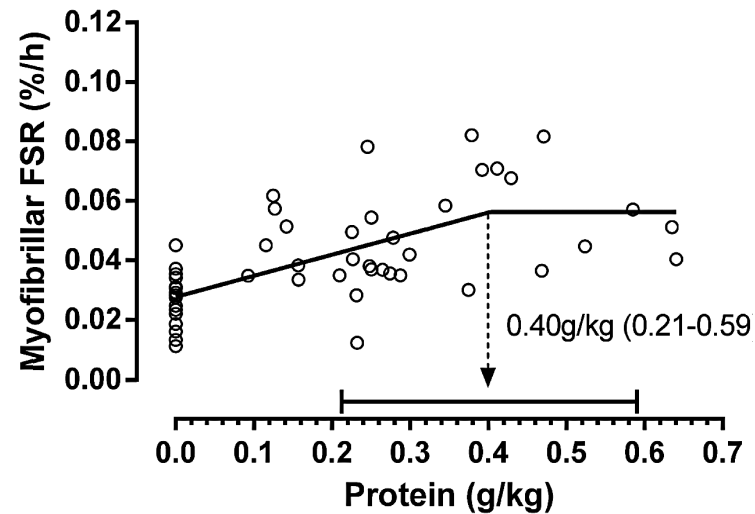
Moore DR et al. J Gerontol A Biol Sci Med Sci. 2015;70(1):57–62

1. Bauer J et al. J Am Med Dir Assoc. 2013;14(8):542–59.
2. Moore DR et al. J Gerontol A Biol Sci Med Sci. 2015;70(1):57–62.

# Protein Distribution Through the Day



- To maximize MPS, **crossing an anabolic threshold** may be necessary.
  - 25–30 g protein per meal<sup>1</sup>
  - 0.4 g/kg/meal of protein<sup>2</sup>



Moore DR et al. J Gerontol A Biol Sci Med Sci. 2015;70(1):57–62



- Ideal consumption pattern remains to be elucidated
  - Evaluate & adjust nutritional interventions from time to time

1. Bauer J et al. J Am Med Dir Assoc. 2013;14(8):542–59.  
2. Moore DR et al. J Gerontol A Biol Sci Med Sci. 2015;70(1):57–62.



# Energy Provision Critical

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- An adequate intake of protein needs to be **accompanied by appropriate energy intake of 30 kcal/kg body weight/day** for older adults.<sup>1</sup>
  - Further individualized based on clinical and patient factors.<sup>1</sup>
  - <https://www.healthhub.sg/programmes/94/calorie-calculator>
- **Recommendations to Practice:**
  -  70 kg man: 2100 kcal/d
  -  50 kg woman: 1500 kcal/d

1. Volkert D et al. Clin Nutr. 2019;38(1):10–47.

# Sample meal for 2100 kcal, 80 g protein

---

## Breakfast:

- 3 slices of wholemeal bread + peanut butter and soft margarine
- 3 soft boiled eggs (1 yolk)
- 1 glass of Milk

## Lunch:

- 1.5 bowl of brown rice
- 1 palm size of meat
- ¼ plate of vegetable
- 1 fruit

## Dinner:

- 1.5 bowl of brown rice
- 1 palm size of fish
- 1 small firm tofu
- ¼ plate vegetable
- 1 fruit

# Sample meal for 1500 kcal, 60 g protein

---

## Breakfast:

- 2 slices of wholemeal bread + peanut butter and soft margarine
- 2 soft boiled eggs (1 yolk)
- 1 glass of Milk

## Lunch:

- 1 bowl of brown rice
- 1 palm size of meat
- $\frac{1}{4}$  plate of vegetable
- 1 fruit

## Dinner:

- 1 bowl of brown rice
- 1 palm size of fish
- $\frac{1}{4}$  plate vegetable
- 1 fruit



# Energy and Protein Provision

- Utilize online calculator from the Health Promotion Board to determine the energy values and nutrition composition of foods.<sup>1</sup>

The screenshot shows the 'Energy & Nutrient Composition of Food' web application. It features a search form with the following elements:

- Food Name:** A text input field.
- Food Group:** A dropdown menu with the text '-- Select Food Group --'.
- Nutrient \*:** A dropdown menu with the text '-Select-'.
- Food Sub-Group:** A dropdown menu with the text '-- Select Food SubGroup --'.
- Units:** Two radio buttons: 'Per Serving' (selected) and 'Per 100g edible portion'.
- Buttons:** 'Search' and 'Reset Search Criteria'.
- Footnote:** '\* By default, these nutrition components will be shown: Energy, Carbohydrate, Protein, Total Fat, Saturated Fat, Dietary Fibre, Cholesterol and Sodium.'
- Timestamp:** 'Last Modified: 14/03/2011'.

1. Health Promotion Board Singapore. Energy & Nutrient Composition of Food; 2011. Available at: <https://focos.hpb.gov.sg/eservices/ENCF/>.



# Oral Nutrition Supplements (ONS) Recommended



World Health  
Organization

- **WHO** recommends oral supplemental nutrition (from food fortification to ONS) plus dietary advice for older adults with undernutrition in the community setting.<sup>1</sup>

## Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity



### Citation

World Health Organization. (2017). Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity. World Health Organization. <https://apps.who.int/iris/handle/10665/258981>. License: CC BY-NC-SA 3.0 IGO

Export

### Description

ix, 46 p.  
The Japanese version is published by Japanese Public Health Association  
The Portuguese version is published by PAHO: <https://iris.paho.org/handle/10665.2/53357>

- **ESPEN:** In older adults with chronic conditions with or at risk of malnutrition, ONS are strongly recommended when dietary counselling and food fortification is insufficient to meet nutritional goals.<sup>2</sup>

Practice Guideline > Clin Nutr. 2019 Feb;38(1):10-47. doi: 10.1016/j.clnu.2018.05.024.

Epub 2018 Jun 18.

**ESPEN guideline on clinical nutrition and hydration in geriatrics**

1. World Health Organization. Integrated care for older people. Guidelines on community-level interventions to manage declines in intrinsic capacity. 2017. Available from: <https://apps.who.int/iris/handle/10665/258981>.
2. Volkert D et al. Clin Nutr. 2019;38(1):10-47.

# Categories of ONS

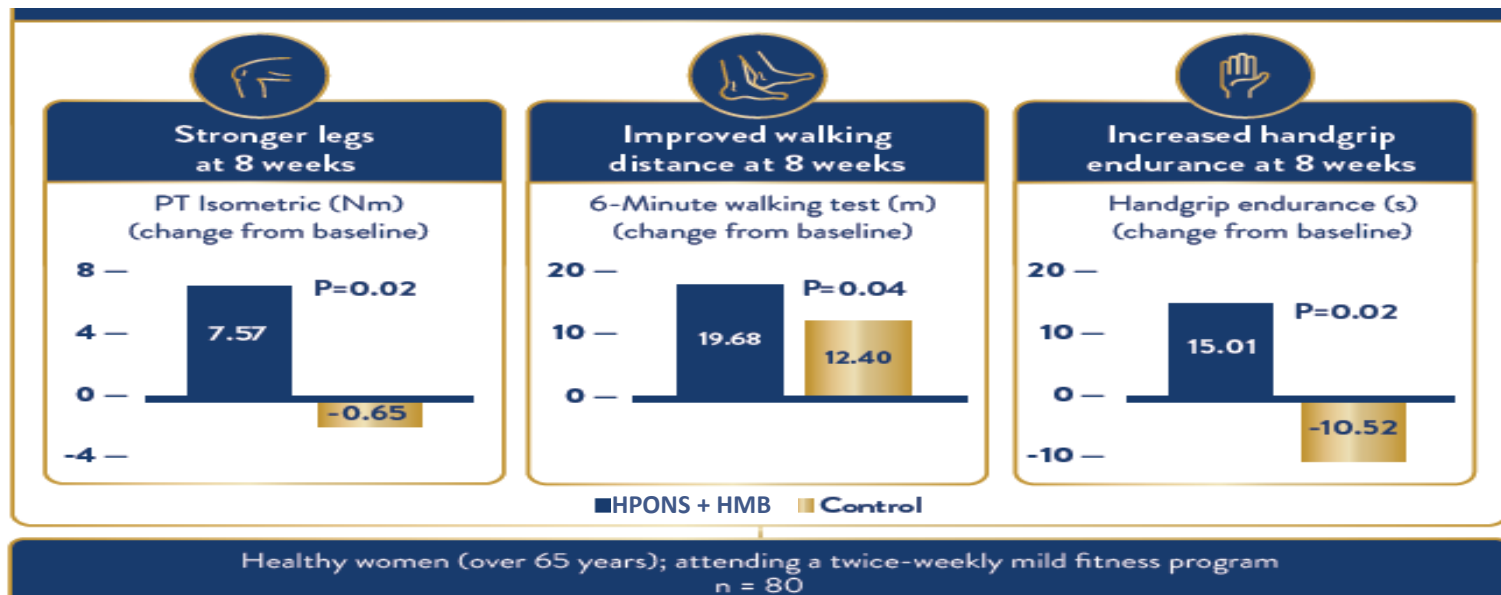
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- Standard
- High calorie, high protein
- Disease specific
  - Diabetes
  - Renal failure



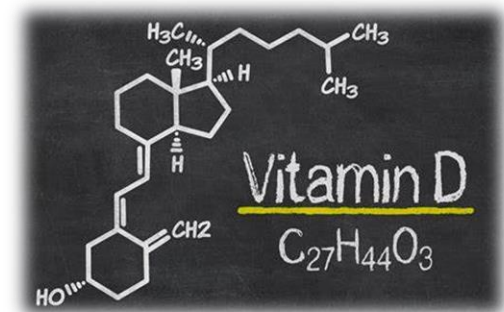
# High Protein ONS with HMB for Strength

- High protein ONS with HMB (HPONS + HMB; 1.5 g/day) may increase muscle strength in the presence of resistance exercise in community dwelling older women.<sup>2</sup>



1. Berton L et al. PLoS One. 2015;10(11):e0141757

# Recommendation 10



Meeting the recommended daily intake of **vitamin D (600–800 IU)** may improve **muscle strength** across the continuum of care and vitamin D deficiency should be treated.

Chew et al. BMC Geriatrics (2021) 21:1314  
<https://doi.org/10.1186/s12877-021-02240-8>

BMC Geriatrics

RESEARCH ARTICLE Open Access

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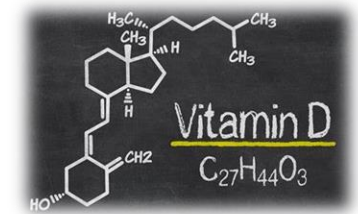
Diagnosis of sarcopenia should be based on low muscle strength and low muscle mass (bioimpedance analysis, dual-energy X-ray absorptiometry or calf circumference as a surrogate). The severity of sarcopenia should be determined by assessment of physical performance (gait speed or 5-times chair stand test ≥12 s as a surrogate for gait speed). To treat sarcopenia, we recommend a combination of progressive resistance-based exercise training and optimization of nutritional intake (energy, protein and functional ingredients). High quality protein in sufficient quantity, to overcome anabolic resistance in older adults, and distributed throughout the day to enable maximum muscle protein synthesis, is essential. The addition of resistance-based exercise training is synergistic in improving the sensitivity of muscle protein synthesis response to the provision of amino acids and reducing anabolic resistance. An expected dose-response. (Continued on next page)

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

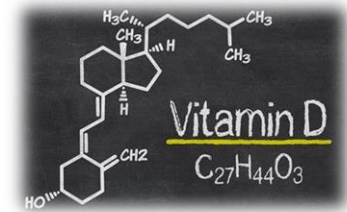
# Vitamin D & Muscle Health



- Vitamin D is vital for maintaining normal muscle function.
- In patients with sarcopenia, a target serum vitamin D of > 30 µg/L is recommended to optimize outcomes.

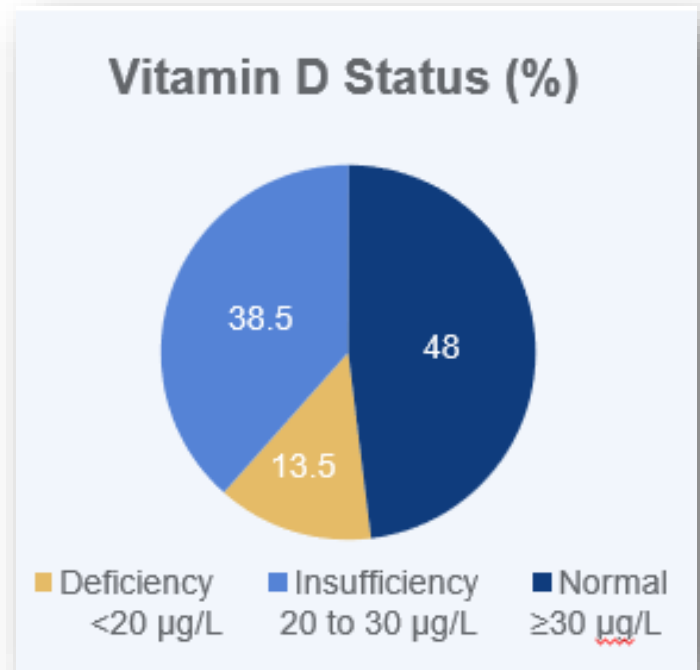
Chew STH et al. Clin Nutr. 2021 Apr;40(4):1879-1892

# Vitamin D Status in Singapore



- **Community-dwelling older adults in Singapore who are not at risk of malnutrition**<sup>1</sup>

- Vit D insufficiency (20–30 µg/L): 38.5%
- Vit D deficiency (< 20 µg/L): 13.5%

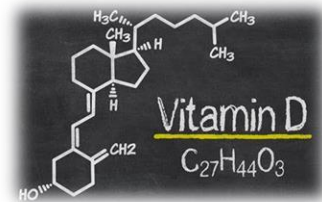


1. Cheong M, et al. Nutrients. 2020;12(11):3329.

# Vitamin D recommendations

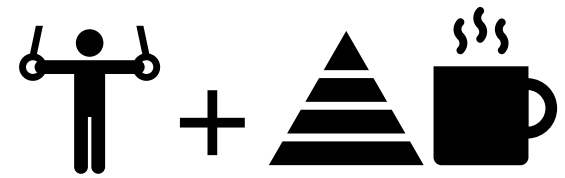


- At present, routine serum vitamin D testing in the general population is not recommended.
- **Daily intake of 600–800 IU of vitamin D is recommended for older adults.<sup>1</sup>**
- Vitamin D supplementation has a **small beneficial effect on muscle strength.<sup>2</sup>**
  - In patients > 65 years who are vitamin D deficient, **replacement with oral cholecalciferol 50,000 units weekly may be beneficial until the serum level is above 30 µg/L<sup>3</sup>**, particularly in the context of sarcopenia.<sup>4, 5</sup>



1. Ross AC et al. J Clin Endocrinol Metab. 2011;96:53–8.
2. Beaudart C et al. J Clin Endocrinol Metab. 2014;99(11):4336–45.
3. Holick MF et al. J Clin Endocrinol Metab. 2011;96:1911–30.
4. Beaudart C et al Arch Public Health. 2014;72(1):45.
5. Verlaan S et al Clin Nutr. 2018;37(2):551–7.

# Recommendation 11



# R<sub>x</sub>

A combination of physical activity and nutritional interventions is strongly recommended for optimal muscle health in patients with malnutrition or at risk of malnutrition.

Chew et al. *BMC Geriatrics* (2021) 21:314  
http://doi.org/10.1186/s12877-021-02240-8

BMC Geriatrics

RESEARCH ARTICLE Open Access

Singapore multidisciplinary consensus recommendations on muscle health in older adults: assessment and multimodal targeted intervention across the continuum of care

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**Abstract**

**Background:** The rapidly aging societies worldwide and in Singapore present a unique challenge, requiring an integrated multidisciplinary approach to address high-value targets such as muscle health. We propose pragmatic evidence-based multidisciplinary consensus recommendations for the assessment and multi-modal management of muscle health in older adults (≥65 years) across the continuum of care.

**Methods:** The recommendations are derived from an in-depth review of published literature by a multidisciplinary working group with clinical experience in the care of the older population in both acute and community settings.

**Results:** The panel recommends screening for muscle impairment using the SARC-F questionnaire, followed by assessment for low muscle strength (handgrip strength or 5-times chair stand test ≥10 s as a surrogate for lower limb strength) to diagnose possible/probable sarcopenia. For uncomplicated cases, lifestyle modifications in exercise and diet can be initiated in the community setting without further assessment. Where indicated, individuals diagnosed with possible/probable sarcopenia should undergo further assessment. Diagnosis of sarcopenia should be based on low muscle strength and low muscle mass (bioimpedance analysis, dual-energy X-ray absorptiometry or calf circumference as a surrogate). The severity of sarcopenia should be determined by assessment of physical performance (gait speed or 5-times chair stand test ≥12 s as a surrogate for gait speed). To treat sarcopenia, we recommend a combination of progressive resistance-based exercise training and optimization of nutritional intake (energy, protein and functional ingredients). High quality protein in sufficient quantity, to overcome anabolic resistance in older adults, and distributed throughout the day to enable maximum muscle protein synthesis, is essential. The addition of resistance-based exercise training is synergistic in improving the sensitivity of muscle protein synthesis response to the provision of amino acids and reducing anabolic resistance. An expected dose-response (Continued on next page)

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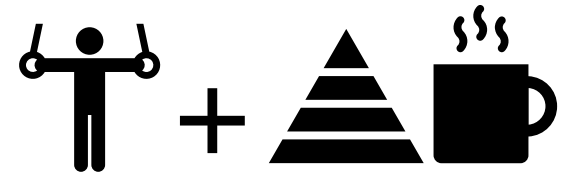
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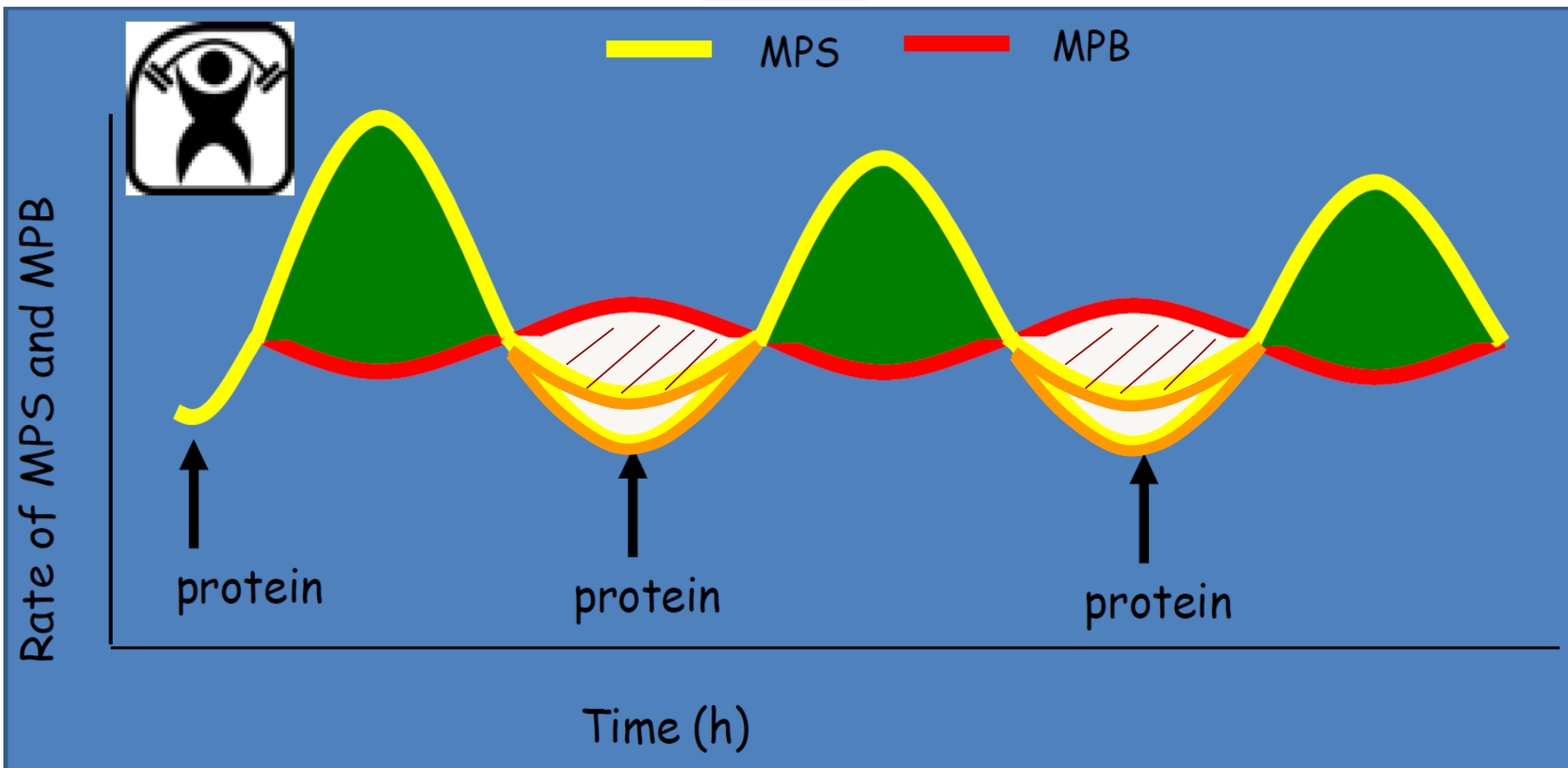
# Exercise + nutrition

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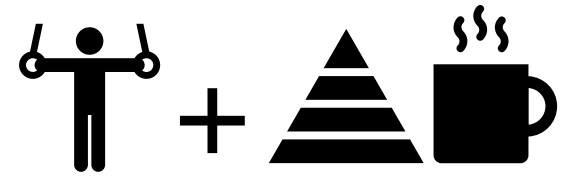


- **Combining exercise and nutrition** is an **effective therapeutic intervention** for sarcopenia<sup>1</sup> and for improving muscle health in older adults with or at risk of malnutrition.<sup>2</sup>

1. Dent E et al. J Nutr Health Aging. 2018;22(10):1148–61
2. Volkert D et al. Clin Nutr. 2019;38(1):10–47.



# Protein + RET Augments Muscle Health



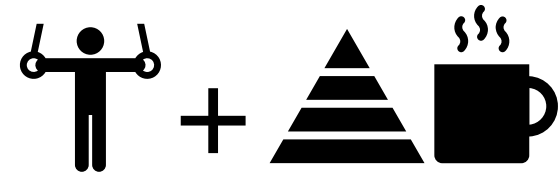
- Protein supplementation augments muscle mass and strength gains from prolonged RET in older adults.<sup>1</sup>
- A meta-analysis found that protein supplementation has a stronger effect in preventing loss of muscle mass and leg strength in older adults at risk of sarcopenia and frailty compared with RET alone.<sup>2</sup>

1. Cermak NM et al. Am J Clin Nutr. 2012;96(6):1454–64.

2. Liao CD et al. Am J Clin Nutr. 2017; 106:1078–91.

# Timing Protein & Exercise

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- Performing **exercise in close temporal proximity to the nutrition intervention** or protein-rich meal has been shown to be beneficial for muscle anabolism.<sup>1</sup>
- Physical activity **improves the sensitivity of MPS response** to the provision of amino acids and reduces anabolic resistance.
- This **enhanced response is sustained for days** after resistance-based training.<sup>2</sup>

1. Paddon-Jones D et al. Am J Clin Nutr. 2015;101(6): 1339S–45S.
2. Burd NA, Gorissen SH, van Loon LJ. Exerc Sport Sci Rev. 2013;41(3):169–73.

# Evidence-based Nutritional Interventions to Support Muscle Health

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- R<sub>x</sub>** 8. **Adequate calorie and protein diet** support muscle health for healthy community-dwelling older adults.
- R<sub>x</sub>** 9. **Supplementation of protein and calories**, either via whole foods and/or high protein oral nutrition supplements, should be the primary focus of any nutrition interventions aimed at optimizing muscle health and recovery in hospitalized patients.
- R<sub>x</sub>** 10. **Meeting the recommended daily intake of vitamin D** (600–800 IU) may improve muscle strength across the continuum of care and vitamin D deficiency should be treated.
- R<sub>x</sub>** 11. **A combination of physical activity and nutritional interventions is strongly recommended** for optimal muscle health in patients with malnutrition or at risk of malnutrition.