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FM ACP RESEARCH GRAND ROUND Progressive Resistance Exercise Training for Muscle Health

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Chew STH, Kayambu G, Lew CCH, Ng TP, Ong F, Tan J, Tan NC, Tham SL. Singapore multidisciplinary consensus recommendations on muscle health in older adults: assessment and multimodal targeted intervention across the continuum of care. BMC Geriatr. 2021 May 17;21(1):314.

Acknowledgment

- Singapore Physiotherapy Association
- Abbot
- National University Hospital

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Recommendation 7

- **Progressive resistance/weight-based training** is effective for improving muscle mass, strength and physical performance.



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Recommendation 7

- In general, for older adults age 65 and above, **more physical activity (frequency, duration and/or volume) leads to greater benefits** as per the 2020 WHO Guidelines [1].



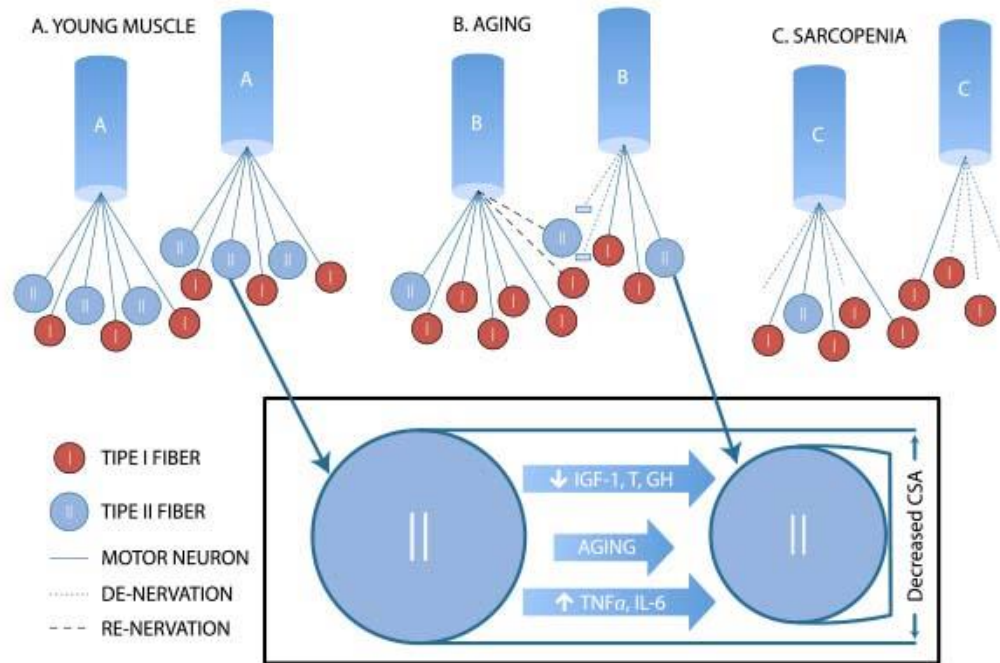
¹ World Health Organization. WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization; 2020. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK566045/>. Accessed 22 Feb 2021

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Aging Muscle



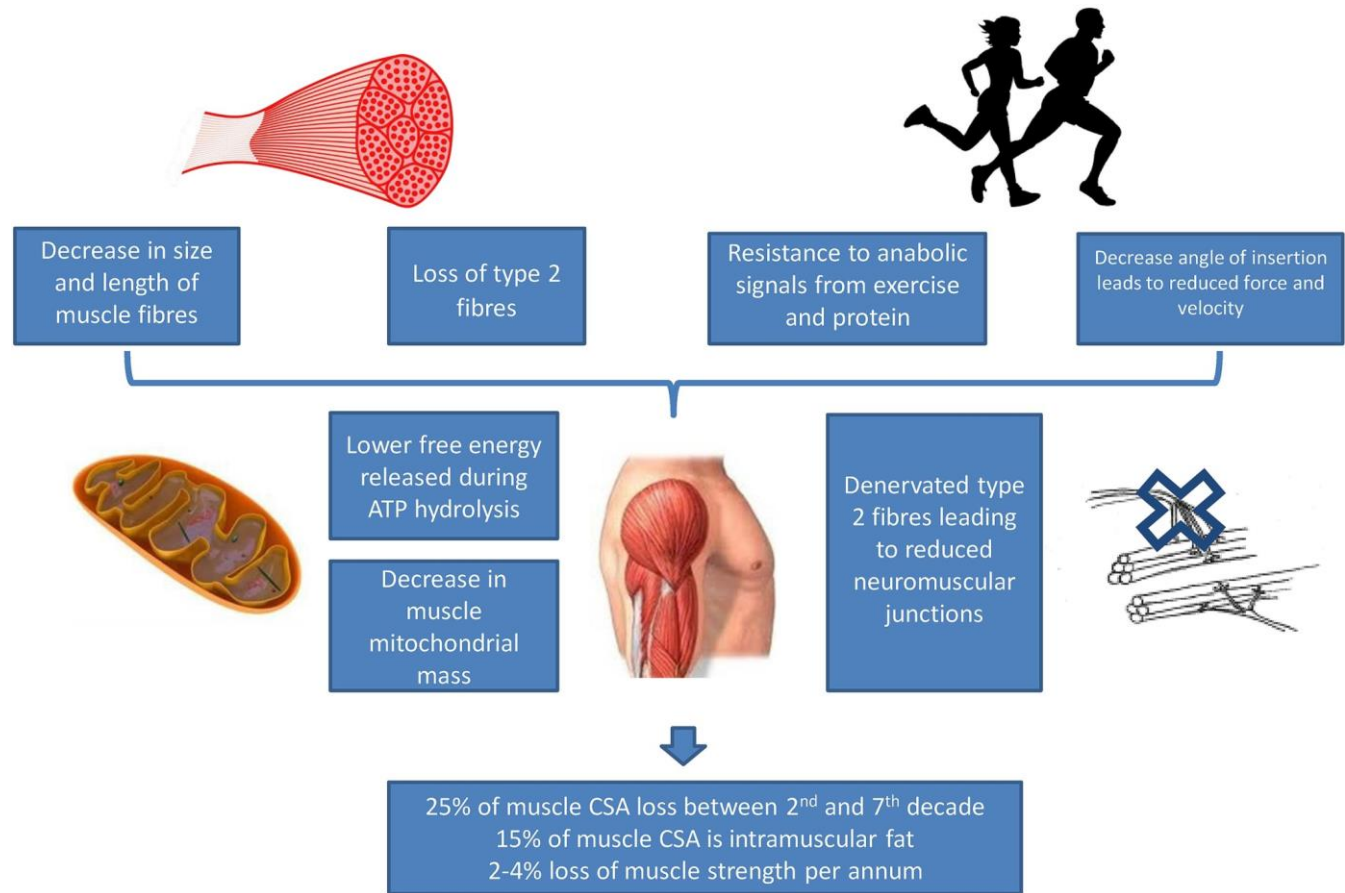
AGE ON MUSCLE



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Aging Muscle

- 25% Muscle loss
- 15% Muscle Fat
- 2-4% Strength loss / year



Daisy Wilson, Thomas Jackson, Elizabeth Sapey, Janet M. Lord. Frailty and sarcopenia: The potential role of an aged immune system, Ageing Research Reviews, Volume 36, 2017, Pages 1-10

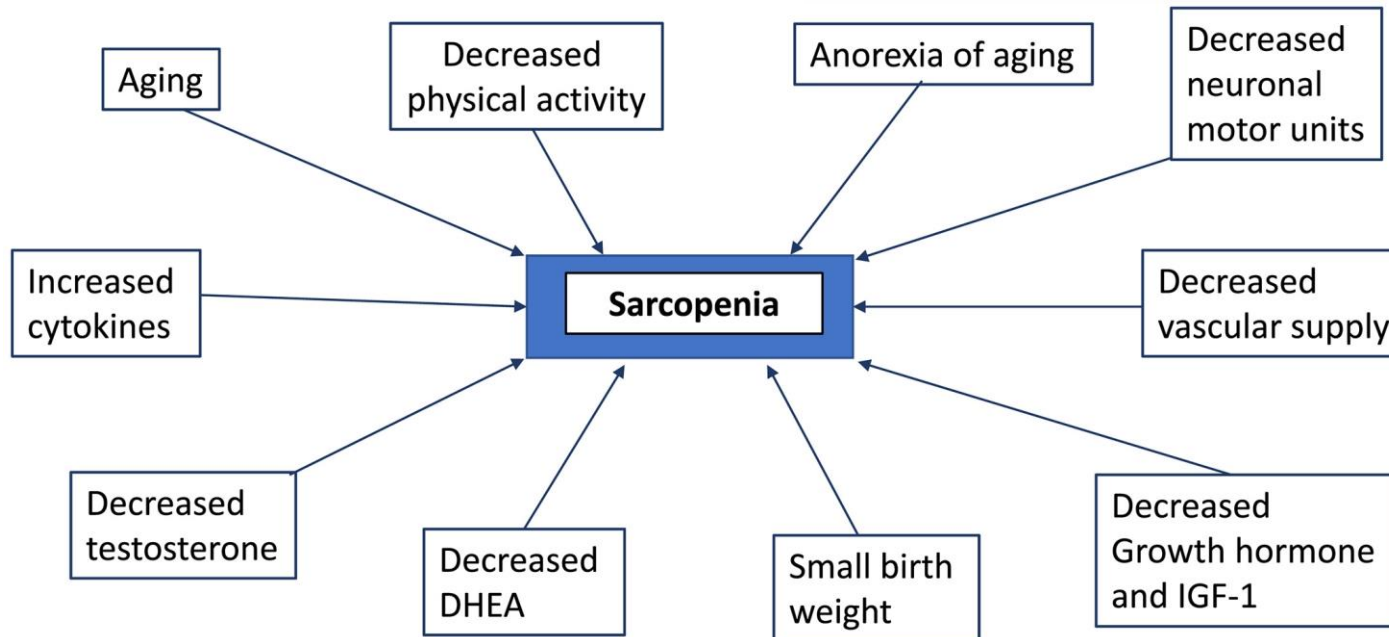
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Sarcopenia

Sarcopenia: A Time for Action. An SCWD Position Paper

Juergen Bauer, John E. Morley✉, Annemie M.W.J. Schols, Luigi Ferrucci, Alfonso J. Cruz-Jentoft, Elsa Dent, Vickie E. Baracos, Jeffrey A. Crawford, Wolfram Doehner, Steven B. Heymsfield, Aminah Jatoi, Kamyar Kalantar-Zadeh, Mitja Lainscak, Francesco Landi, Alessandro Laviano, Michelangelo Mancuso, Maurizio Muscaritoli, Carla M. Prado, Florian Strasser, Stephan von Haehling, Andrew J.S. Coats, Stefan D. Anker ... See fewer authors ^

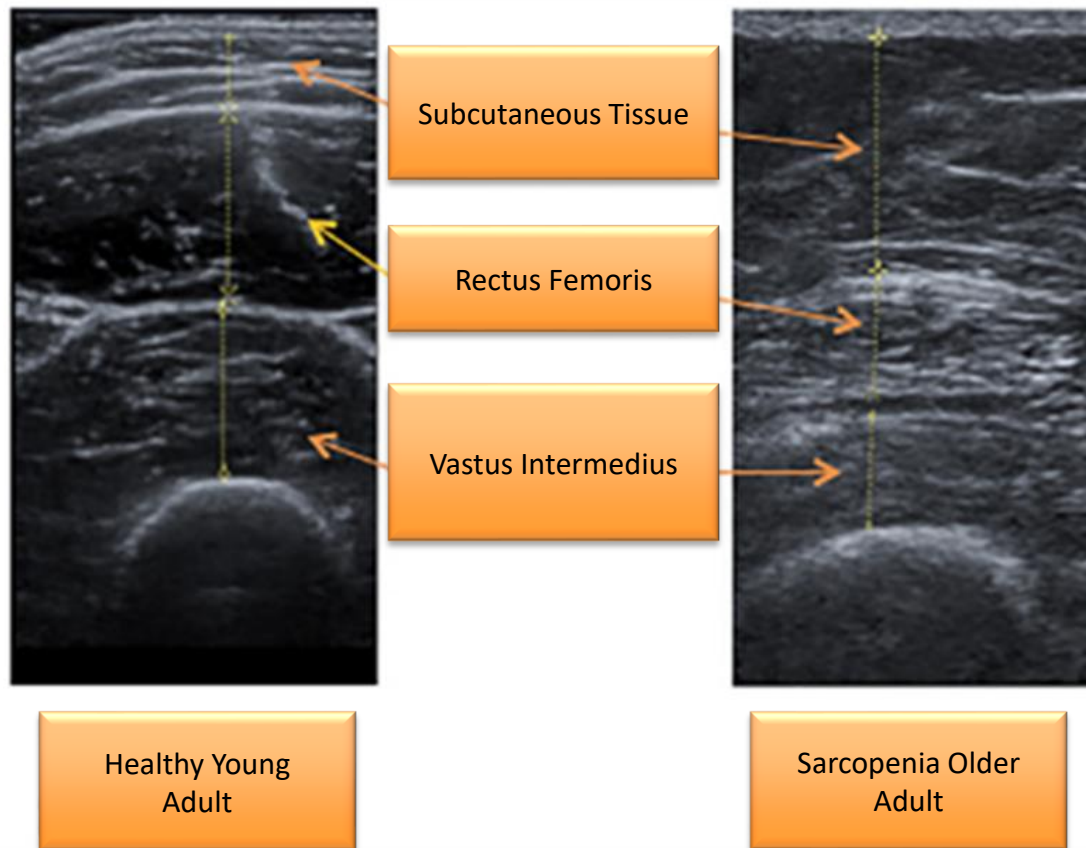
First published: 15 September 2019 | <https://doi.org/10.1002/jcsm.12483> | Citations: 110



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Sarcopenia

Ultrasound echogenicity of healthy younger and sarcopenic older adult



Stringer, H., & Wilson, D. (2018). The Role of Ultrasound as a Diagnostic Tool for Sarcopenia. *The Journal of Frailty & Aging*, 7, 258 - 261.

Recommendation 7

- The International Clinical Practice Guidelines for Sarcopenia prescribes **progressive RET** as the firstline therapy for **sarcopenia** [2].

> [J Nutr Health Aging. 2018;22\(10\):1148-1161. doi: 10.1007/s12603-018-1139-9.](#)

International Clinical Practice Guidelines for Sarcopenia (ICFSR): Screening, Diagnosis and Management

- The American College of Sport Medicine strongly recommends **RET to increase strength and power in older adults** [3].



**AMERICAN COLLEGE
of SPORTS MEDICINE[®]**
LEADING THE WAY

²Dent E, Morley JE, Cruz-Jentoft AJ, Arai H, Kritchevsky SB, Guralnik J, et al. International clinical practice guidelines for sarcopenia (ICFSR): screening, diagnosis and management. *J Nutr Health Aging.* 2018;22(10):1148–61.

³American College of Sports Medicine. American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc.* 2009;41:1510–30.

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RET - Benefits



- Evidence has demonstrated the benefit of exercise training, especially **RET for ≥ 3 months**, in **improving muscle mass, strength and gait speed** in older adults [4-8].

⁴Cruz-Jentoft AJ, Landi F, Schneider SM, Zuniga C, Arai H, Boirie Y, et al. Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. Report of the international sarcopenia initiative (EWGSOP and IWGS). *Age Ageing*. 2014;43(6):748–59

⁵Steffl M, Bohannon RW, Sontakova L, Tufano JJ, Shiells K, Holmerova I. Relationship between sarcopenia and physical activity in older people: a systematic review and meta-analysis. *Clin Interv Aging*. 2017;12:835–45

⁶Peterson MD, Rhea MR, Sen A, Gordon PM. Resistance exercise for muscular strength in older adults: a meta-analysis. *Ageing Res Rev*. 2010;9(3):226–37.

⁷Peterson MD, Sen A, Gordon PM. Influence of resistance exercise on lean body mass in aging adults: a meta-analysis. *Med Sci Sports Exerc*. 2011;43(2):249–58.

⁸Yoshimura Y, Wakabayashi H, Yamada M, et al. Interventions for treating sarcopenia: a systematic review and meta-analysis of randomized controlled studies. *J Am Med Dir Assoc*. 2017;18:553.e1–553.e16.

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Resistance Exercise Training as a Primary Countermeasure to Age-Related Chronic Disease

Jonathan C. Mcleod, Tanner Stokes and Stuart M. Phillips*

Department of Kinesiology, McMaster University, Hamilton, ON, Canada

RET - Benefits

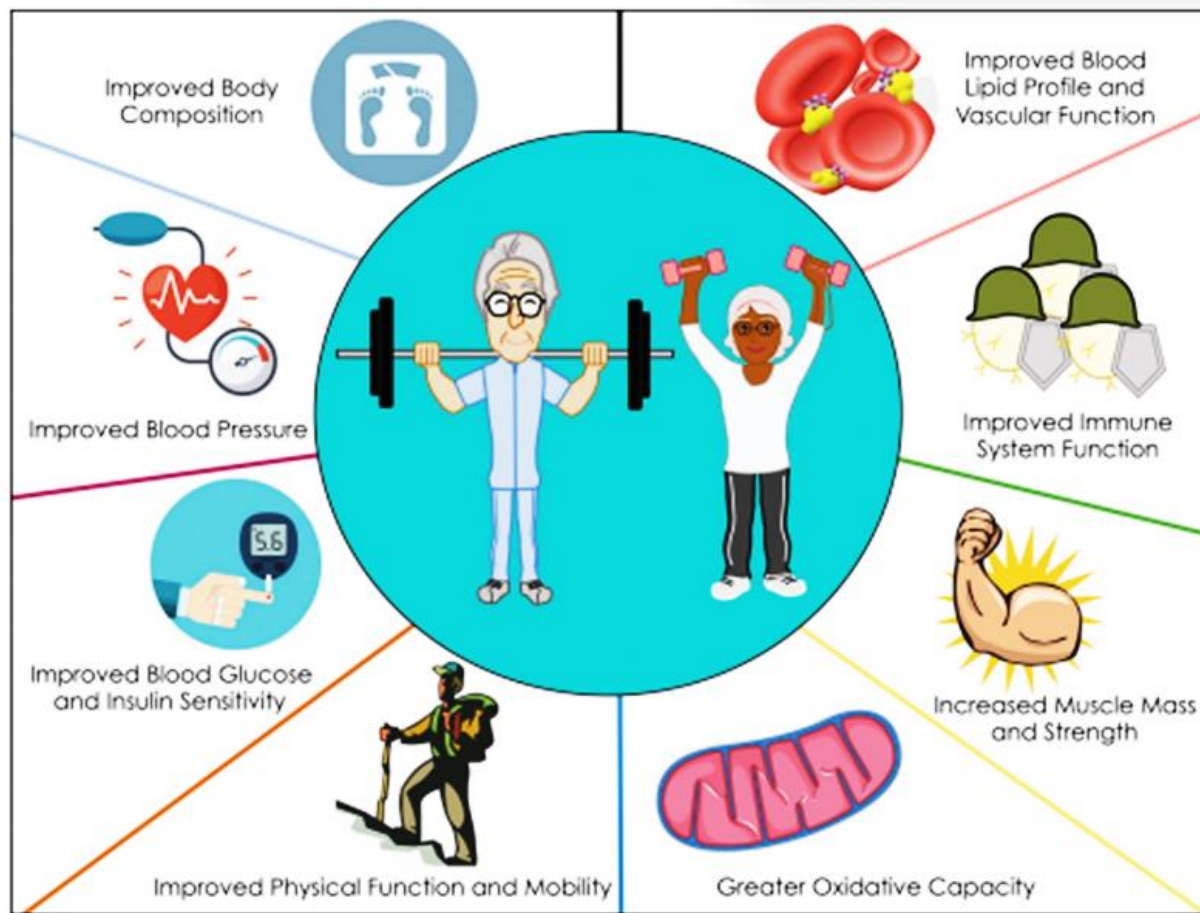
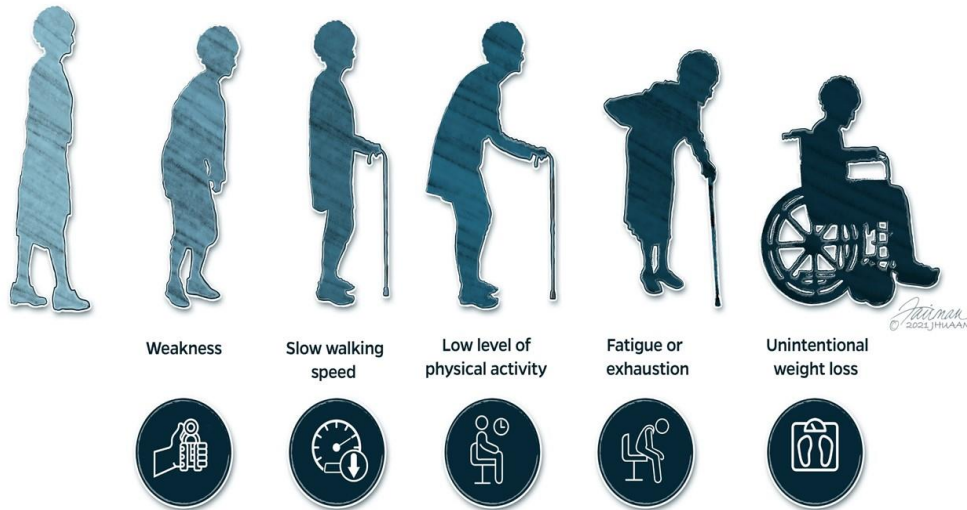


FIGURE 2 | Proposed mechanisms whereby RET influences chronic disease risk.

RET – Frail Older Adults



[Aging Clinical and Experimental Research](#)

August 2018, Volume 30, Issue 8, pp 889-899 | [Cite as](#)

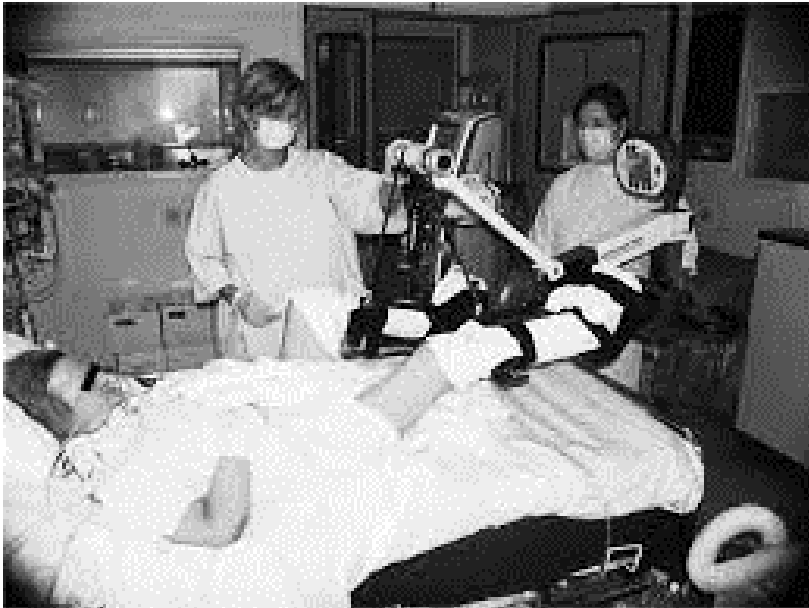
Benefits of resistance training in physically frail elderly: a systematic review

Source : <https://www.hopkinsmedicine.org/>

- Frequency of **1-6 sessions** per week, training volume of **1-3 sets of 6-15 repetitions** and intensity of **30-70%1-RM** promoted significant enhancements on muscle strength, muscle power, and functional outcomes.
- **Supervised and controlled RET** represents an effective intervention in frailty treatment

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RET – Hospitalised Older Adults



BMC Geriatrics



Research article

Open Access

The Feasibility of performing resistance exercise with acutely ill hospitalized older adults

Laurie H Mallery*¹, Elizabeth A MacDonald², Cheryl L Hubley-Kozey³, Marie E Earl³, Kenneth Rockwood¹ and Chris MacKnight¹

Using a standardized and simple exercise regimen, selected, ill, older adults in the hospital are able to comply with resistance exercise.

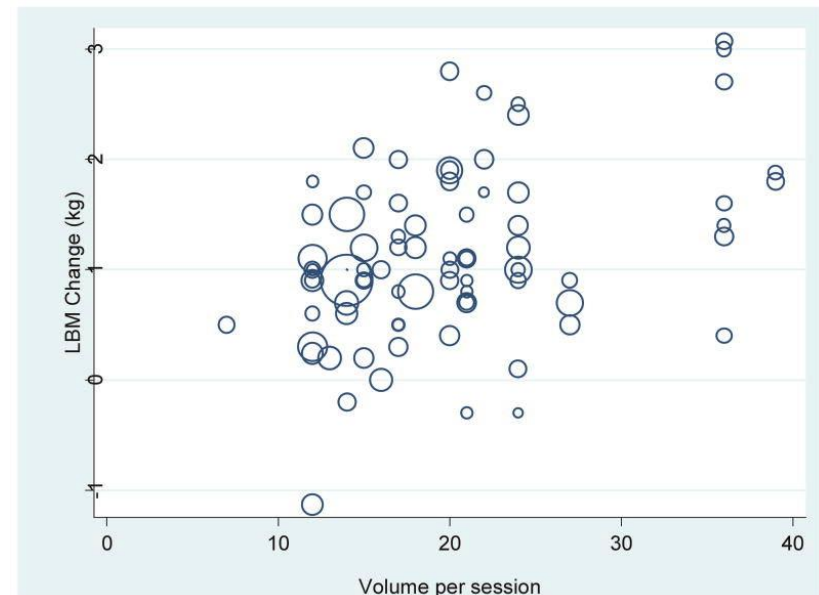
Burtin C, Clerckx B, Robbeets C, Ferdinande P, Langer D, Troosters T, Hermans G, Decramer M, Gosselink R. Early exercise in critically ill patients enhances short-term functional recovery. Crit Care Med. 2009 Sep;37(9):2499-505. doi: 10.1097/CCM.0b013e3181a38937. PMID: 19623052.

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RET – Lean Body Mass

- **Higher RET volume** (total repetitions [number] x external load [kg]) is associated with **greater improvements in LBM**, with every additional **10 sets of exercise performed per session** leading to an **expected gain of 0.5 kg in LBM** [9].



⁹ Peterson MD, Sen A, Gordon PM. Influence of resistance exercise on lean body mass in aging adults: a meta-analysis. Med Sci Sports Exerc. 2011;43(2): 249–58.

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RET – Build Strength

- With each incremental increase in exercise intensity from **low** (< 60% 1- repetition maximum [RM]) to **low/moderate** (60-69% 1- RM), **low/moderate** (60-69% 1 RM) to **moderate/ high** (70-79% 1-RM), and **moderate/high** (70-79% 1-RM) to **high** (> 80% 1 RM), a **5.5% increase in strength is expected** [10-12].

Published: 25 April 2019

Exercise Interventions for the Prevention and Treatment of Sarcopenia. A Systematic Umbrella Review

[D. Beckwée](#), [A. Delaere](#), [S. Aelbrecht](#), [V. Baert](#), [C. Beaudart](#), [O. Bruyere](#), [M. de Saint-Hubert](#), [Ivan Bautmans](#) & [Sarcopenia Guidelines Development Group of the Belgian Society of Gerontology and Geriatrics \(BSGG\)](#)

[The journal of nutrition, health & aging](#) **23**, 494–502 (2019) | [Cite this article](#)

¹⁰ Peterson MD, Rhea MR, Sen A, Gordon PM. Resistance exercise for muscular strength in older adults: a meta-analysis. *Ageing Res Rev.* 2010;9(3):226–37.

¹¹ Law TD, Clark LA, Clark BC. Resistance exercise to prevent and manage sarcopenia and dynapenia. *Annu Rev Gerontol Geriatr.* 2016;36(1):205–28.

¹² Beckwée D, Delaere A, Aelbrecht S, et al. Exercise interventions for the prevention and treatment of sarcopenia. A systematic umbrella review. *J Nutr Health Aging.* 2019;23(6):494–502.

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12 week RCT – Consensus

- A consensus was reached on a **12-week structured RET-based exercise program for older adults** can be implemented in terms of **specificity, overload and progression** exercise prescription principles [13-17].

**TARGET
SPECIFIC MUSCLES**

¹³ American College of Sports Medicine. American College of Sports Medicine position stand. Exercise and physical activity for older adults. Med Sci Sports Exerc. 2009;41:1510–30.

**OVERLOAD MUSCLES
GRADUALLY**

¹⁴ Law TD, Clark LA, Clark BC. Resistance exercise to prevent and manage sarcopenia and dynapenia. Annu Rev Gerontol Geriatr. 2016;36(1):205–28.

¹⁵ Peterson MD, Gordon PM. Resistance exercise for the aging adult: clinical implications and prescription guidelines. Am J Med. 2011;124(3):194–8.

**PROGRESS WEIGHTS
ACCORDINGLY**

¹⁶ Avers D, Brown M. White paper: strength training for the older adult. J Geriatr Phys Ther. 2009;32:148–52.

¹⁷ Willoughby DS. Current comments are official statements by the American College of Sports Medicine concerning topics of interest to the public at large. Indianapolis: American College of Sports Medicine; 2015. Resistance Training and the Older Adult (ACSM Current Comment (Normal))



12 week RET – Develop Muscle Bulk

- The application of **moderate or greater intensity muscle** strengthening exercises **2 or more days a week** receives a **strong recommendation with moderate certainty of evidence by the WHO Guidelines 2020 [18]**.

**MODERATE OR
HIGHER INTENSITY**

**> OR = 2 DAYS A
WEEK**

¹⁸ World Health Organization. WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization; 2020. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK566045/>. Accessed 22 Feb 2021

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12 week RET - Recommendation

Table 4 Example of a 12-week structured RET-based exercise program^a

Week	1-2	3-4	5-6	7-8	9-10	11-12
Aim	Attain Adaptability		Develop Muscle Bulk		Build Strength	
Type [101]	Postural stabilization, Body weight		Closed chain exercises	Free weights, open chain exercises		
Frequency (alternate days per week)	1-2	1-2	2	2	2-3	2-3
^b Intensity (number of repetitions to fatigue) [101, 102]	20 low	15 low	12 moderate	10 moderate	8-10 moderate-high	6-8 high
Volume (number of sets)	1	1-2	2	2-3	2-3	3
Specific muscle groups	Core: <i>Abdominals</i> <i>Back</i> <i>Chest</i> Proximal Stabilisers: <i>Shoulders</i> <i>Hips</i> <ul style="list-style-type: none"> • Wall push ups • Bench presses • Crunches • Lunges • Mini Squats • Bridging 		Distal Peripherals: <i>Arms</i> <i>Legs</i> Proximal Stabilisers: <i>Shoulders</i> <i>Hips</i> Core: <i>Abdominals</i> <i>Back</i> <i>Chest</i> <ul style="list-style-type: none"> • Resistance Bands • Weight Machine Stations • Arm Ergometry • Leg Pedal 		Distal Peripheral: <i>Arms</i> <i>Legs</i> Proximal Stabilisers: <i>Shoulders</i> <i>Hips</i> Core: <i>Abdominals</i> <i>Back</i> <i>Chest</i> <ul style="list-style-type: none"> • Dumbbells • Weight Machine Stations 	

^aAdapted and modified from Peterson MD, Gordon PM. Resistance exercise for the aging adult: clinical implications and prescription guidelines. *Am J Med* 2011;124(3):194-8

^bProgression of intensity – initially, the intensity of the exercise (weight or resistance loading) may be increased when the subject can achieve ≥ 20 repetitions in good form – indicative that current resistance is below the 60% 1RM threshold required for muscle strengthening [102, 103]. Progressively, the load can be adjusted higher to reflect higher intensity through the number of repetitions to fatigue or reduced ability to retain good form. Higher intensity RET can attain fatigue and should be stopped before strain of the training muscle

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Strength Training



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RET - Type

Table 1. The Type of Resistance Exercise Training Program

Type	Description	Examples
Isometric RE	A static contraction of muscle against external resistance without change in its length or joint motion	Yoga poses such as Plank or the Warrior variations, side bridge, hundred breaths exercise, pushing against a fence
Isotonic RE	A dynamic exercise against resistance as a muscle lengthens or shortens through the available range of motion <ul style="list-style-type: none"> - Concentric contraction: an active muscle undergoes shortening while overcoming external resistance - Eccentric contraction: an active muscle undergoes lengthening while being overcome by an external resistance 	Contraction of biceps curl with fixed weight Extension of quadriceps during knee bend
Isokinetic RE	An active exercise in which a muscle or group of muscles contracts against a controlled accommodating resistance that is moving at a constant angular velocity	Fitness machines (e.g., stationary bike, bench press machine, bent-over row), dynamometer

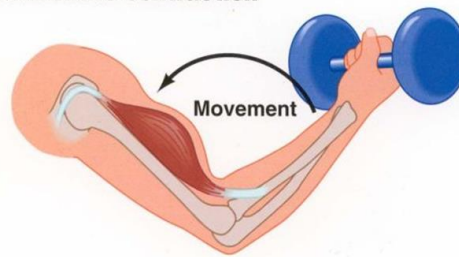
RE, resistance exercise.

Isometric contraction

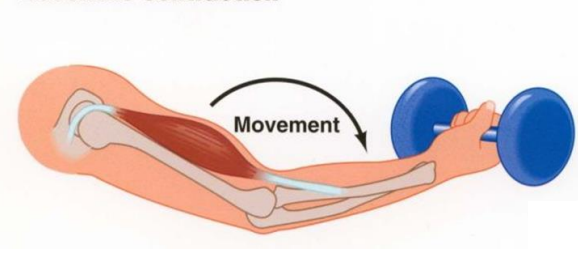
Muscle contracts but does not shorten



Concentric contraction



Eccentric contraction



Source: Vickphysiotherapy.com
 Hong and Kim. Effect of resistance exercise on bone health.
 Endocrinol Metab 2018.

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RET- Type



RET- Type



Vickphysiotherapy.com

- **Tips when training with Resistance Bands:**
- A neutral posture should be maintained. Concentrate on aligning the neck, shoulder blade and shoulder joint, pelvis, lower back, hips while contracting the core abdominals and bending the knees slightly.
- Stick with the prescribed sets and repetitions. Remember to rest between every set as directed.
- Perform all exercises in a slow and controlled manner.
- Avoid going into extreme joint positions when exercising e.g. locking the joint at the end of a movement.
- Breathe evenly while performing these exercises. Exhale while contracting the muscles and inhale while releasing. Don't hold your breath.
- Start off by performing the exercises without the resistance band until you are comfortable with the movement, then add the resistance.



1-4 week RET (low) – Attain Adaptability

1-2	3-4
-----	-----

Attain Adaptability

Postural stabilization, Body weight

1-2	1-2
20	15
low	low
1	1-2

Core:

Abdominals

Back

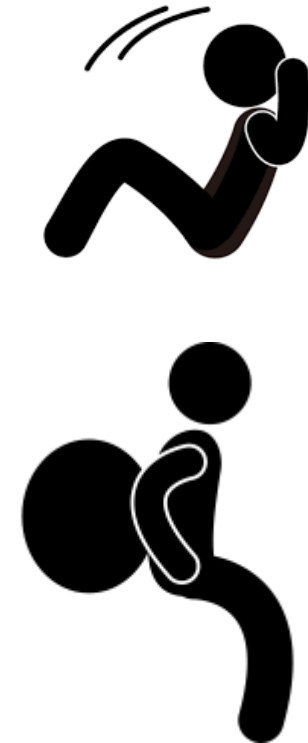
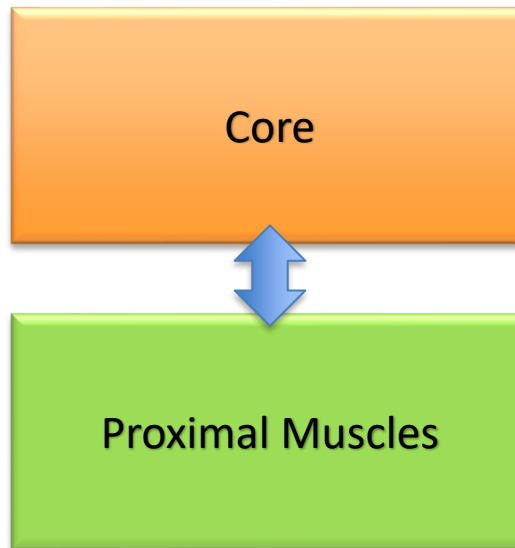
Chest

Proximal Stabilisers:

Shoulders

Hips

- Wall push ups
- Bench presses
- Crunches
- Lunges
- Mini Squats
- Bridging

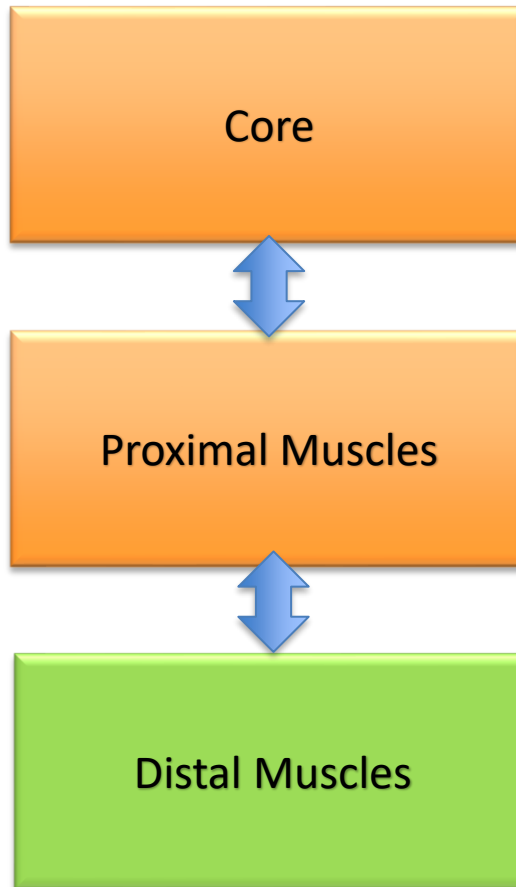


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5-8 week RET (Mod) – Develop Muscle Bulk

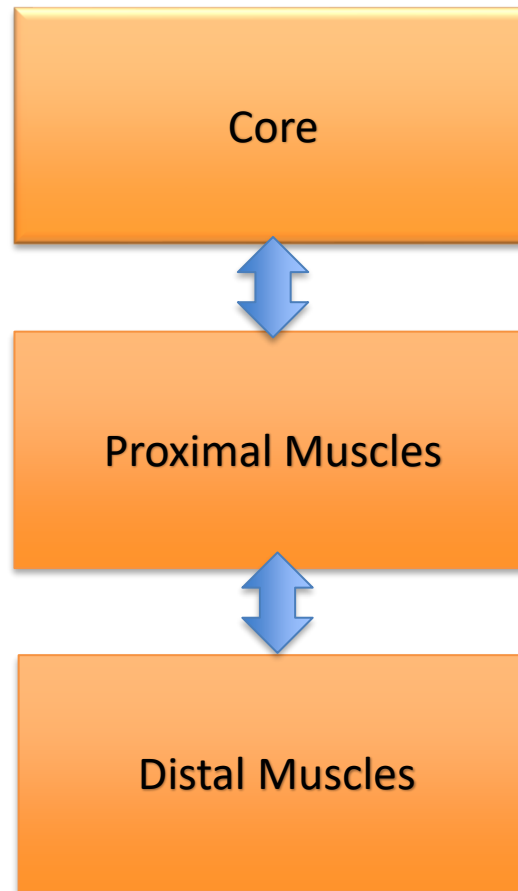
5-6	7-8
Develop Muscle Bulk	
Closed chain exercises	Free weights,
2	2
12 moderate	10 moderate
2	2-3
Distal Peripherals:	
<i>Arms</i>	
<i>Legs</i>	
Proximal Stabilisers:	
<i>Shoulders</i>	
<i>Hips</i>	
Core:	
<i>Abdominals</i>	
<i>Back</i>	
<i>Chest</i>	
<ul style="list-style-type: none"> • Resistance Bands • Weight Machine Stations • Arm Ergometry • Leg Pedal 	



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9-12 week RET (high) – Build Strength

9-10	11-12
Build Strength	
open chain exercises	
2-3	2-3
8-10	6-8
moderate-high	high
2-3	3
Distal Peripheral:	
Arms	
Legs	
Proximal Stabilisers:	
Shoulders	
Hips	
Core:	
Abdominals	
Back	
Chest	
• Dumbbells	
• Weight Machine Stations	



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RPE BORG Scale

- The Borg scale allows individuals to **rate their level of exertion during exercise** and can be used as a simplified alternative to gauge exercise intensity. [19,20].

Borg's Rating of Perceived Exertion (RPE) Scale	
Perceived Exertion Rating	Description of Exertion
6	No exertion; sitting and resting
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

¹⁹ Borg G. Borg's perceived exertion and pain scales. Champaign: Human Kinetics; 1998.

²⁰ Borg GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc.1982;14(5):377-81.

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RPE BORG Scale

EXPERT REVIEW OF CARDIOVASCULAR THERAPY
<https://doi.org/10.1080/14779072.2019.1561278>



REVIEW

Check for updates

Rating of perceived exertion on resistance training in elderly subjects

Shinichiro Morishita^a, Atsuhiko Tsubaki^a, Masatoshi Nakamura^a, Satoshi Nashimoto^b, Jack B. Fu^c and Hideaki Onishi^a

^aInstitute for Human Movement and Medical Sciences, Niigata University of Health and Welfare, Niigata, Japan; ^bDepartment of Rehabilitation, Niigata Medical Centre, Niigata, Japan; ^cDepartment of Palliative, Rehabilitation & Integrative Medicine, University of Texas MD Anderson Cancer Center, Houston, TX, USA

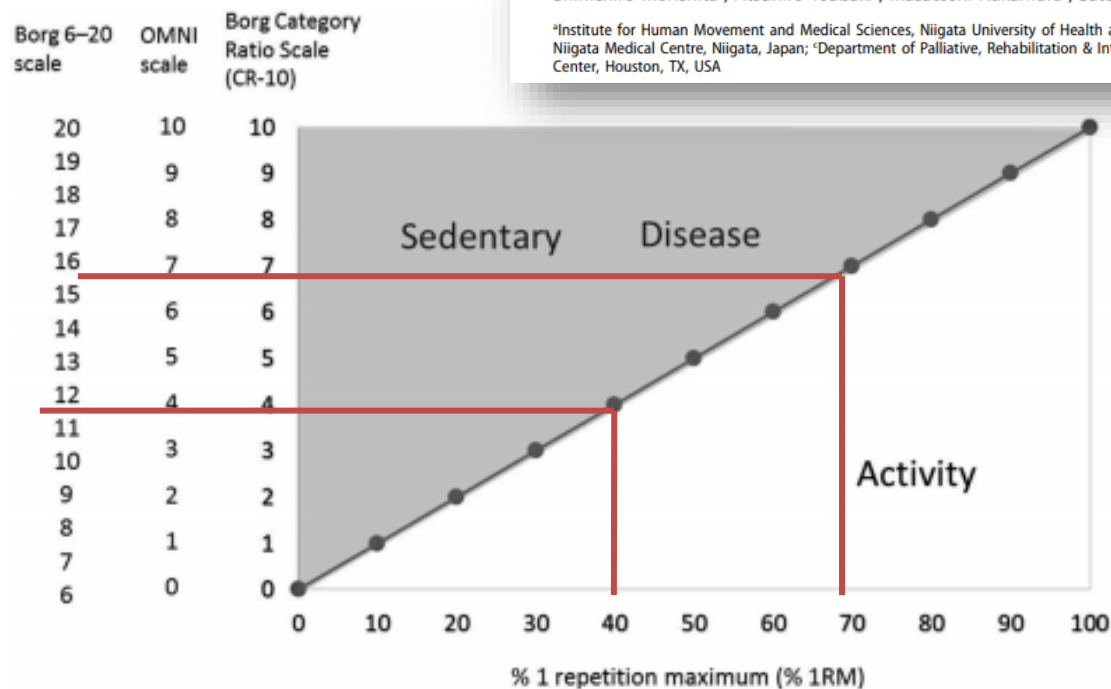


Figure 2. The relationship between the percentage of 1RM and the RPE scale. RPE was related to several repetitions of %1RM. If elderly individuals performed 2–3 sets and 10 repetitions of resistance exercises at 10% 1RM, then the RPE scores could be 7 using the Borg 6–20 RPE scale, 4 using the Borg CR-10 scale, and 1 using OMNI scale after training. Furthermore, sedentary elderly and ill elderly tended to have higher RPE during resistance training than active elderly.

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RET – Safety Tips



1. Warm up and cool down properly.
2. Use proper form to avoid injuries and maximize gains.
3. Breathe out when you are lifting or pushing; breathe in as you slowly release the load or weight. Never hold your breath while straining.
4. Don't lock your joints; always leave a slight bend in your knees and elbows when straightening out your legs and arms.
5. Rest muscles for at least 48 hours between strength training sessions.
6. Use lighter weights or less resistance when you first resume exercising.
7. Strength training exercises should not cause pain while you are doing them. If an exercise or movement causes significant pain, stop doing it!
8. Stick with a range of motion that feels comfortable. Over time, try to gradually extend that range.



Fitness Parks



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Strength Training for Seniors



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Thank You