# Age-Related Muscle Loss Protocol‡

DEVELOPED IN COLLABORATION WITH OUR SCIENTIFIC AND MEDICAL ADVISORS

This protocol was designed with our clinician partners to help you deliver the most effective care. Included are recommendations to support foundational well-being and targeted interventions for muscle health. This protocol includes products from Pure Encapsulations® partner brand, Klean Athlete®.‡

## FOUNDATIONAL SUPPORT

**Diet:**

- Phytonutrient-rich diet
- Adequate calorie intake. Recommended protein intake:
  - Minimum 1.2-2.2 g/kg of ideal body weight per day
  - Postmenopausal women: 1.8-2.3 g/kg of ideal body weight per day

**Exercise**

- Resistance training 2-3 times per week
- Additional light to moderate aerobic exercise or HIIT training, for 30-60 minutes, 2-3 times per week

In addition to a healthy diet and lifestyle, consider the following supplements to help meet daily nutrient needs and support overall well-being:‡

- Longevity Nutrients (LGN21 / LGN22)
- O.N.E.™ Omega (ONO6 / ONO3)
- Probiotic-G.I (PGI6)
- Calcium Magnesium (Citrate) (CM1 / CM9)
- Vitamin $D_3$ 25 mcg (1,000 IU) (VD11 / VD12 / VD16)

## FOCUSED SUPPORT

The products in this category support common clinical objectives related to age-related muscle loss. Choose from the options listed below, as applicable, based on your clinical objectives:‡

| CLINICAL OBJECTIVE‡ | ASSESSMENT* | PRODUCT RECOMMENDATIONS‡ | SUGGESTED USE |
|---|---|---|---|
| **Muscle Mass and Function** | Anthropometric measurements, dietary intake and muscle strength assessments | klean ATHLETE<br>Klean Casein Protein<br>(Order Code: KA57776P-658)<br>Supplies 24 grams of high-quality protein from micellar casein in each serving. Casein is a slow digesting protein usually taken before bed to support recovery and reduce muscle breakdown during sleep<br>Available in two delicious flavors Chocolate and Vanilla Custard<br>or<br>klean ATHLETE<br>Klean Isolate<br>(Order Code: KA57534P-720)<br>Supplies 20 grams of high-quality, unsweetened and unflavored, whey protein isolate in each serving.<br>Also available in two delicious flavors Chocolate, Vanilla, and Strawberry | 1 scoop daily mixed with 10-12 ounces of water or another beverage |

‡This statement has not been evaluated by the Food & Drug Administration. This product is not intended to diagnose, treat, cure or prevent any disease.

## FOCUSED SUPPORT (CONTINUED)

The products in this category support common clinical objectives related to age-related muscle loss. Choose from the options listed below, as applicable, based on your clinical objectives:‡

| CLINICAL OBJECTIVE‡ | ASSESSMENT* | PRODUCT RECOMMENDATIONS‡ | SUGGESTED USE |
|---|---|---|---|
| **Energy & Cellular Health** | Muscle strength assessments | **RENUAL**<br>(Order Code: RNL6)<br>Enhances mitochondrial renewal to support energy output & muscle function | 2 capsules, 1-2 times daily, with or between meals |
| | Dietary assessment and/or self-reported need for joint support | **Astaxanthin**<br>(Order Code: AST1 / AST6)<br>Protects the phospholipid membranes of cells from oxidative damage and supports joint function and comfort | 1 capsule, 1-3 times daily, with meals |
| **Muscle strength, Performance, & Recovery** | Anthropometric measurements and muscle strength assessments | **Creatine**<br>(Order Code: CRM6)<br>Creatine monohydrate supports quick conversion of ADP to ATP energy, helps reduce recovery time, and supports muscle strength and performance. | Take this product with an adequate daily fluid intake. Mix 1 ½ tsp daily with 8 oz of water or beverage of choice. For best results, take this product with a carbohydrate-containing beverage or food 30 minutes before exercise, or immediately following exercise. On rest days, take 1 serving daily with a meal or as directed |

## ADDITIONAL CONSIDERATIONS

The products in this category offer alternative or added support. Choose from the options listed below, as applicable, based on your clinical objectives:‡

| CLINICAL OBJECTIVE‡ | ASSESSMENT* | PRODUCT RECOMMENDATIONS‡ | SUGGESTED USE |
|---|---|---|---|
| **Muscle Health** | Anthropometric measurements, dietary intake and muscle strength assessments | **BCAA Capsules**<br>(Order Code: BCA9 / BCA2)<br>Supports lean muscle mass and exercise recovery<br><br>Also available as:<br>**BCAA Powder** (BCAP) | 2 capsules, 1-2 times daily, between meals |
| **Cellular & Antioxidant Support** | Serum coenzyme $Q_{10}$ | **Ubiquinol-QH 100 mg**<br>(Order Code: UQ16)<br>Active antioxidant form of $CoQ_{10}$ that supports the production of ATP for energy and provides antioxidant support | 1 capsule, 1-2 times daily, with meals |

| CLINICAL OBJECTIVE‡ | ASSESSMENT* | PRODUCT RECOMMENDATIONS‡ | SUGGESTED USE |
|---|---|---|---|
| **Cellular & Antioxidant Suppor** (Continued) | HsCRP, Whole blood glutathione, GlycA | **Liposomal Glutathione**<br>(Order code: LSG3 / LSG6)<br>An innovative liposomal form that promotes protection from free radicals to support healthy cellular function<br><br>or<br><br>**NAC + Glycine Powder**<br>(Order Code: NGY1)<br>Promotes antioxidant defenses and the body's natural detoxification process. Reduces oxidative stress associated with aging | 2 capsules daily with a meal<br><br>1 scoop daily, mixed with 8 ounces of water, between meals |
| **Protein Digestion** | Malabsorption: self-reported post prandial GI symptoms | **Digestive Enzymes *Ultra***<br>(Order code: DEU1 / DEU9)<br>An innovative liposomal form that promotes protection from free radicals to support healthy cellular function<br><br>or<br><br>**Digestive Enzymes *Ultra* w/Betaine HCl**<br>(Order Code: DEUB / DEUB9)<br>Supports protein, carbohydrate, fat, fiber and dairy digestion. Supports optimal gastric pH with betaine HCl, important for the enhanced digestion of protein | 2 capsules with each meal<br><br>2 capsules with each meal |
| | Malabsorption with low stomach acid: older age, higher dietary protein intake, Betaine Challenge, self-reported post prandial GI symptoms | | |

Available for download at PureEncapsulationsPro.com/Protocols

## The Mitochondria's Role in Muscle Health

Skeletal muscle has high energy demands, relying heavily on mitochondria to sustain muscle mass, strength and functional performance.[1] Beyond ATP production for muscle contraction, mitochondria play a central role in maintaining cellular and metabolic homeostasis that support muscle health, particularly with aging.[2]

Optimal mitochondrial function is essential for preserving muscle integrity, neuromuscular signaling and physical function over time.

## Mitochondrial Quality Control

Mitochondrial health is maintained through tightly regulated processes that ensure an efficient and resilient mitochondrial network:

- **Mitochondrial biogenesis**: expansion of the mitochondrial pool
- **Fusion and fission**: dynamic remodeling to adapt to cellular demands
- **Mitophagy**: selective removal and recycling of altered mitochondria

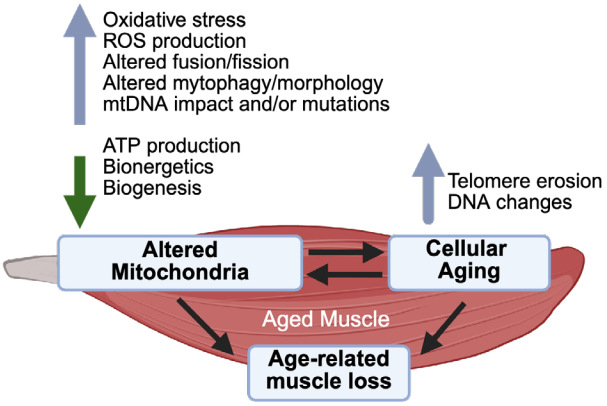
Mitophagy acts as a key quality control mechanism, helping retain only efficient, functional mitochondria within muscle cells.[3]

## Aging, Mitochondria and Muscle Decline

With aging, mitochondrial structure and function can change, often accompanied by alterations in mitophagy. These alterations can contribute to:[4,5,6,7]

- Energy deficits within muscle cells
- Disruption in the balance between anabolic and catabolic processes
- Changes in muscle mass, strength, motor neuron integrity and muscle fiber health

Collectively, these factors may increase the risk of reduced mobility, loss of independence and altered ability to perform activities of daily living.[4,5,6,7]




*Created with BioRender.com*
*Adapted from Ferri E et al. Int J Mol Sci. 202. 21:5236*

## Clinical Relevance

Mitochondria are highly adaptable organelles and can respond rapidly to systemic and cellular stressors. Supporting mitochondrial function may help[2]:

- Preserve muscle mass and strength with aging
- Enhance mitochondrial dynamics and mitophagy
- Changes in muscle mass, strength, motor neuron integrity and muscle fiber health

Although both sedentary and physically active individuals are susceptible to age-related muscle decline, the severity is highly variable and influenced by multiple factors, including hormone and cytokine balance, nutritional status and level and consistency of physical activity.[8]

## Exercise and Nutrition Strategies to Support Muscle Health in Aging Adults

### Exercise: Core Therapeutic Strategy

Physical inactivity is a major modifiable risk factor for age-related muscle loss. Both resistance and aerobic exercise improve skeletal muscle health by enhancing mitochondrial quality, muscle strength and physical function in older adults.[8,9,10,11] Exercise should be considered a foundational intervention for the prevention and management of age-related muscle decline.

### Clinical Recommendations:

- **Exercise modalities**:
  - Resistance training
  - Aerobic training
  - Combined resistance and aerobic training
- **Frequency**: 2–3 sessions per week
- **Session duration**: 30–60 minutes
- **Program length**: Minimum of 8–12 weeks to observe meaningful benefit

## Exercise and Nutrition Strategies to Support Muscle Health in Aging Adults (Continued)

Programs should be individually tailored based on baseline fitness, comorbidities and functional capacity. Progression of training load (e.g., weight, repetitions, distance, intensity or number of exercises) should occur gradually and be guided by patient tolerance, functional improvement and safety.

**Key clinical considerations:**

- Start below maximal capacity and progress incrementally
- Emphasize consistent participation over intensity early on
- Reassess strength, endurance and functional performance regularly
- Combine exercise with nutritional support for optimal outcomes

## Nutrition: Addressing Anabolic Resistance

Forty percent of older adults fail to meet minimum protein requirements, increasing the risk of reduced muscle protein synthesis ("anabolic resistance") and muscle loss.[12] Age-related changes in digestion, nutrient absorption, appetite and mitochondrial function may further shift muscle metabolism toward catabolism and oxidative stress.[13,14,15,16]

**Clinical priorities include assessment and optimization of:**

- Protein intake
- Overall diet quality and antioxidant exposure

**Protein intake recommendations:**[17]

- Up to age 65: **0.8 g per kg body weight** (≈0.8 g per 2.2 lb)
- Over age 65: **≥1.0 g per kg body weight** (≈1.0 g per 2.2 lb)

Protein intake should be distributed evenly across meals when possible and adjusted for renal function and clinical context.

### Dietary Pattern Considerations

Higher intake of antioxidant-rich foods, particularly fruits and vegetables, is associated with improved muscle preservation.[18] Dietary patterns that support mitochondrial health and reduce oxidative stress can complement exercise interventions.

### Clinical Guidance:

- Encourage a Mediterranean-style dietary pattern, emphasizing**:**
  - Adequate high-quality protein
  - Fruits, vegetables and fiber-rich foods
  - Polyphenol-rich plant foods
- Combine dietary strategies with individualized exercise programs for best results

### Clinical takeaway:

A combined approach that integrates structured, progressive exercise with adequate protein intake and antioxidant-rich dietary patterns offers an effective, evidence-informed strategy to support muscle health, functional capacity and healthy aging in older adults.

*All assessments may not be necessary. Testing should be performed at the discretion of the healthcare provider.
The information contained herein is for informational purposes only and does not establish a doctor-patient relationship.

## REFERENCES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