Prevent **Age-Related Muscle Loss, Frailty** *and* **Risk Factors** *for* **Falls**

Every adult loses muscle mass with age.[1]

This is not just a cosmetic issue.

Age-related **muscle loss** increases the risk for falls, fractures, loss of independence, and ultimately, loss of life.

This decline in muscle mass, which begins as early as the 4th decade, is called **sarcopenia**.[2] It leads to increased nursing home placement and hospitalization rates.[3] And as muscle mass falls, the risk of **disability** greatly increases.[4,5]

Exercise can help prevent age-related muscle loss, but is only one of the components necessary to maintain adequate muscle strength.

Two key nutrients have been shown to ***rebuild lost muscle*** in aging individuals:

Beta-hydroxy beta-methylbutyrate (HMB) increases and preserves muscle mass in adults of all ages, especially those older than 65.[6-8]

Vitamin D3 supports muscle strength and helps to prevent the falls that often trigger an early decline into frailty.[9-12]

HMB and **vitamin D3** help maintain and restore muscle mass even as we age.

Why Sarcopenia is So Dangerous

Starting around age 40, an estimated **8%** loss of muscle mass is seen **per decade**. After age 70, muscle mass decreases by about **15%** per decade.[1]

This drastic decline leaves individuals not only weaker, but also in less control of their bodies—and more prone to falls and other injuries.

The word for this loss of skeletal muscle mass is ***sarcopenia***.

Sarcopenia triggers a vicious cycle, in which decreased muscle strength limits physical activity, which leads to further muscle loss. Eventually, a condition called ***frailty*** can set in, leaving a person weak and vulnerable to external stressors that would otherwise be minor (such as a mild injury or illness).

As frailty worsens and function declines, each subsequent stressor speeds the road to lost independence and increases the risk of early death.

As we'll now see, clinical evidence supports HMB and vitamin D3 supplementation as a way of heading off sarcopenia and frailty.

HMB Preserves Muscle Mass, Prevents Muscle Atrophy

Beta-hydroxy beta-methylbutyrate, or **HMB**, is a natural, bioactive product of metabolism of the amino acid **leucine**.[13]

HMB is essential to maintaining the balance between muscle ***catabolism*** (breakdown) and ***anabolism*** (buildup or restoration).[14-20]

HMB levels decline with age, a drop that correlates precisely with diminished lean muscle mass and strength.[21] This finding leads to an important question: Can supplementing with HMB protect—or even restore—lean muscle mass in older people?

Multiple human trials have shown the value of HMB for preserving and improving muscle mass.

Overcoming a Major Cause of Sarcopenia

A 2015 meta-analysis included data from seven trials involving a total of 287 older adults. It found that supplementing with HMB preserved muscle mass in older adults and may be useful in preventing muscle atrophy.[22]

One of those studies involved healthy older adults who voluntarily subjected themselves to 10 days of **complete bed rest**[23]—a known cause of **sarcopenia**.[24,25]

Subjects supplemented with either a **placebo** powder or a powder providing **1.5 grams** of **HMB** twice daily, starting five days prior to the bed-rest period and continuing until the end of the rehabilitation phase.

The control group experienced a reduction in total lean body mass of about **4.4 pounds**. In contrast, HMB-supplemented subjects lost just **0.37 pounds** (not a significant difference from baseline).[23]

In this study, HMB supplementation ***preserved lean body mass*** in the face of a powerful stimulus for sarcopenia: sustained bed rest.

What You Need to Know

Protect Against Age-Related Sarcopenia

- **The age-related loss of muscle tissue, called *sarcopenia*, leaves us not only weakened, but vulnerable to falling, increasing the risk for fractures, immobility, and premature death.**
- **Two supplements have been shown to combat sarcopenia by maintaining or boosting muscle mass and performance.**
- **HMB, a derivative of the common amino acid leucine, has been found to enhance lean muscle mass, prevent its loss, and promote improved muscle function.**
- **Vitamin D3 has important effects on aging muscles, including producing significantly greater muscle strength and exercise performance.**
- **Anyone concerned about maintaining optimal muscle mass, strength, and function into their golden years should consider supplementing with a combination of HMB and vitamin D3.**

Boosting Lean Body Mass During Exercise

Other researchers set out to determine if HMB could help boost lean body mass when used in addition to resistance training.

For the study, a group of 70-year-old individuals participated in a resistance training exercise program five days a week. During that time, they took **1 gram** of **HMB** or **placebo** three times a day.[6]

After eight weeks, the supplemented subjects experienced an **increase** in lean body mass of **1.76 pounds**, while the placebo recipients **lost 0.44 pounds**—despite the fact that they were exercising five days a week! Those who supplemented with HMB also lost more body **fat** than the placebo subjects.

This study showed that HMB supplementation can augment strength training in older adults in a way similar to that already proven in younger people.[6]

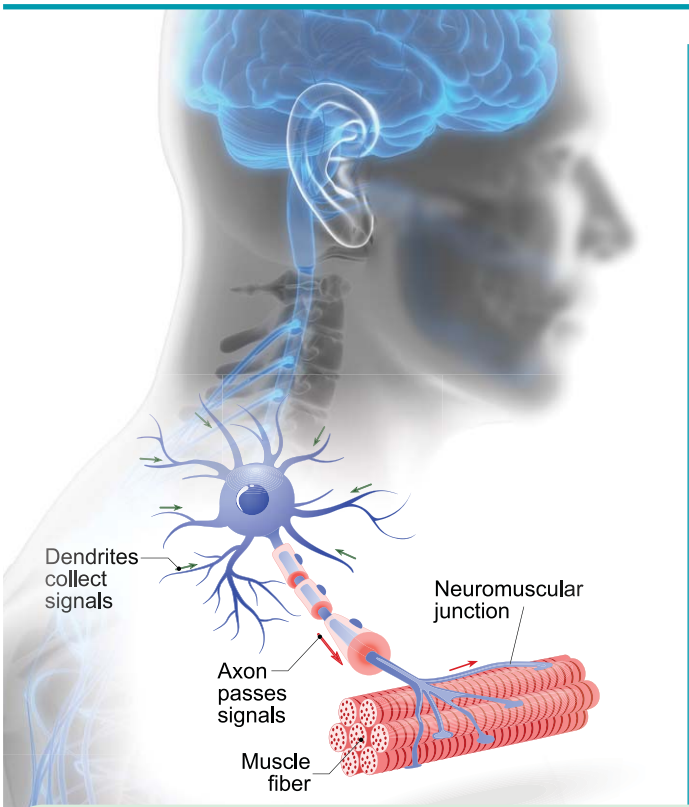
Overall, these studies consistently show that supplementation with HMB improves **lean body mass** in older adults while contributing to better **body fat distribution**.

Vitamin D3 can complement that action by enhancing muscle ***strength***.

Vitamin D3 Boosts Strength and Performance

Vitamin D3 supplementation improves muscle strength and performance.[26,27] Studies show that it's possible to increase muscle strength simply by boosting vitamin D levels.

A **muscle strength/frailty** study enrolled 160 postmenopausal women, aged 50-65, who all had a history of falling.[28] Falls are a common destabilizing factor that can arise from both **inadequate muscle mass** and **poor coordination** and **balance**.[29] Vitamin D3 shows promise for combatting both factors.



Researchers in this study randomly assigned women to receive vitamin D3 (**1,000 IU**/day) or placebo.[28] After nine months, those who took the vitamin D experienced a **25.3%** increase in leg muscle strength.[28] During the same period, women in the **placebo** group *lost* **6.8%** of their lean mass.

The vast difference between the supplemented and unsupplemented women indicates vitamin D's ability to not only preserve—but also **improve**—muscle strength.

Finally, a 2014 meta-analysis of data from 30 randomized controlled trials involving more than 5,600 people evaluated the effects of vitamin D3 supplementation on muscle performance. The results showed that vitamin D3 had a significant positive effect on **overall muscle strength**. This is an important finding, since loss of overall muscle strength can increase the risk of mortality.[26]

The greatest benefits were seen in those who had the lowest vitamin D levels at the beginning of the study (less than **12 ng/mL**) and in older vs. younger subjects.[26] This is good news for those already supplementing with higher-dose vitamin D3.

Beyond Muscle: Neurological Contributions to Age-Related Muscular Dysfunction

Recent research has found that age-related loss of muscle strength cannot be explained by changes in muscle alone.[36] Deterioration of the nervous system likely also contributes to the symptoms of sarcopenia.

The nervous system is critically important for the control of muscular contraction, from the initial planning of movements to the signals that directly activate muscles. Several of these regions involved in control of movement undergo deterioration with age.[36]

For instance, structures in the brain involved in motor planning, initiation, and coordination all demonstrate significant functional decline in the aging process. Likewise, the connections of nerve cells that directly activate muscles undergo changes that negatively affect motor function.

Fortunately, new studies have begun to demonstrate that nutritional factors may ameliorate loss of function both in the nervous system and muscle.[37] These nutrients may contribute both to direct effects on muscles as well as to improvement in nervous system function:

- **Omega-3 fatty acids**, long recognized for their contribution to brain health, improve neuromuscular function as well. Higher levels and supplementation of omega-3s have been associated with improved muscle size and strength.[38-40]
- **Creatine**, an amino acid derivative important for cellular energy supply, appears to benefit both the nervous system and muscle. Recent studies have shown the potential of creatine to prevent loss of muscle mass and improve strength and endurance.[37]
- Increasingly common in older adults, low levels of **vitamin D** have been associated with decline of nervous system function and motor performance. Those individuals with higher levels demonstrate superior motor function compared to those with deficiency; and increased intake in deficient elderly adults results in improved strength and balance and a decreased risk of falls.[37]
- In addition to direct effects in muscle, **HMB** has been shown in laboratory research to prevent some age-related changes in nerve cell connections and promote the growth of new nerve branches.[41,42] These studies may provide a clue to the mechanisms by which HMB supports healthy nervous system control of movement, helping to maintain functional connections in the nervous system and between nerves and muscle.

Combatting Some Underlying Factors of Sarcopenia

There are four primary factors that contribute to **sarcopenia**. Together, either **HMB** or **vitamin D3** mitigate each of these underlying factors. Take a look:

FACTOR #1: Skeletal muscle protein imbalance.

Muscles constantly undergo cycles of breakdown (catabolism) and restoration (anabolism). Muscle mass is simply the sum of catabolic breakdown and anabolic restoration.[30] With aging, the formation of new muscle is greatly reduced, while muscle protein breakdown continues unabated. This imbalance results in decreased muscle mass, or sarcopenia.

→**HMB** exerts pro-anabolic (muscle build-up) and anti-catabolic (anti-breakdown) properties.[20]

FACTOR #2: Shifts in hormone signaling.

Declining sex hormone levels during aging reduce muscle mass, contributing to sarcopenia.

→**Vitamin D** is a steroid hormone that supports both sex hormone synthesis and muscle contractile strength.[31,32]

FACTOR #3: Mitochondrial dysfunction.

Falling numbers and activity of energy-producing mitochondria contribute heavily to sarcopenia.[33]

→Vitamin D3 signaling improves mitochondrial function and dynamics, factors that can increase muscle strength.[34]

FACTOR #4: Inflammatory factors.

As muscles break down, levels of pro-inflammatory markers rise. People with sarcopenia have higher levels of chronic inflammation than those with normal muscle mass.[35]

→**Vitamin D3** has potent immunomodulatory properties and has been linked to improvements in inflammatory markers.[35]

Summary

Sarcopenia is a leading contributor to frailty and early death in older adults.

Two supplements have been shown to combat sarcopenia by maintaining or boosting muscle mass and performance.

HMB promotes muscle growth and function while preventing muscle breakdown. Human studies show that supplementation with HMB contributes to improvements in strength and lean muscle mass.

Supplementation with vitamin D3 has been shown to boost exercise performance and muscle strength.

These two nutrients are available in a combination powder suitable for convenient mixing in any drink of choice and taken once daily. ●

If you have any questions on the scientific content of this article, please call a Life Extension® Wellness Specialist at 1-866-864-3027.

References

1. Kim TN, Choi KM. Sarcopenia: definition, epidemiology, and pathophysiology. *J Bone Metab.* 2013;20(1):1-10.
2. Walston JD. Sarcopenia in older adults. *Curr Opin Rheumatol.* 2012;24(6):623-7.
3. Beaudart C, Rizzoli R, Bruyere O, et al. Sarcopenia: burden and challenges for public health. *Arch Public Health.* 2014;72(1):45.
4. Janssen I, Baumgartner RN, Ross R, et al. Skeletal muscle cutpoints associated with elevated physical disability risk in older men and women. *Am J Epidemiol.* 2004;159(4):413-21.
5. Janssen I, Shepard DS, Katzmarzyk PT, et al. The healthcare costs of sarcopenia in the United States. *J Am Geriatr Soc.* 2004;52(1):80-5.
6. Vukovich MD, Stubbs NB, Bohlken RM. Body composition in 70-year-old adults responds to dietary beta-hydroxy-beta-methylbutyrate similarly to that of young adults. *J Nutr.* 2001;131(7):2049-52.
7. McIntosh ND, Love TD, Haszard JJ, et al. beta-Hydroxy beta-Methylbutyrate (HMB) Supplementation Effects on Body Mass and Performance in Elite Male Rugby Union Players. *J Strength Cond Res.* 2018;32(1):19-26.
8. Sanz-Paris A, Camprubi-Robles M, Lopez-Pedrosa JM, et al. Role of Oral Nutritional Supplements Enriched with beta-Hydroxy-beta-Methylbutyrate in Maintaining Muscle Function and Improving Clinical Outcomes in Various Clinical Settings. *J Nutr Health Aging.* 2018;22(6):664-75.
9. Duval GT, Pare PY, Gautier J, et al. Vitamin D and the Mechanisms, Circumstances and Consequences of Falls in Older Adults: A Case-Control Study. *J Nutr Health Aging.* 2017;21(10):1307-13.
10. Gallagher JC. Vitamin D and falls - the dosage conundrum. *Nat Rev Endocrinol.* 2016;12(11):680-4.
11. Smith LM, Gallagher JC, Suiter C. Medium doses of daily vitamin D decrease falls and higher doses of daily vitamin D3 increase falls: A randomized clinical trial. *J Steroid Biochem Mol Biol.* 2017;173:317-22.
12. Uusi-Rasi K, Patil R, Karinkanta S, et al. A 2-Year Follow-Up After a 2-Year RCT with Vitamin D and Exercise: Effects on Falls, Injurious Falls and Physical Functioning Among Older Women. *J Gerontol A Biol Sci Med Sci.* 2017;72(9):1239-45.
13. Slater GJ, Jenkins D. Beta-hydroxy-beta-methylbutyrate (HMB) supplementation and the promotion of muscle growth and strength. *Sports Med.* 2000;30(2):105-16.
14. Bruckbauer A, Zemel MB. Effects of dairy consumption on SIRT1 and mitochondrial biogenesis in adipocytes and muscle cells. *Nutr Metab (Lond).* 2011;8:91.
15. Feige JN, Lagouge M, Canto C, et al. Specific SIRT1 activation mimics low energy levels and protects against diet-induced metabolic disorders by enhancing fat oxidation. *Cell Metab.* 2008;8(5):347-58.
16. Nissen S, Sharp RL, Panton L, et al. beta-hydroxy-beta-methylbutyrate (HMB) supplementation in humans is safe and may decrease cardiovascular risk factors. *J Nutr.* 2000;130(8):1937-45.
17. Nissen SL, Abumrad NN. Nutritional role of the leucine metabolite -hydroxy -methylbutyrate (HMB). *The Journal of Nutritional Biochemistry.* 1997;8(6):300-11.
18. Smith HJ, Mukerji P, Tisdale MJ. Attenuation of proteasome-induced proteolysis in skeletal muscle by {beta}-hydroxy-{beta}-methylbutyrate in cancer-induced muscle loss. *Cancer Res.* 2005;65(1):277-83.
19. Smith HJ, Wyke SM, Tisdale MJ. Mechanism of the attenuation of proteolysis-inducing factor stimulated protein degradation in muscle by beta-hydroxy-beta-methylbutyrate. *Cancer Res.* 2004;64(23):8731-5.
20. Wilkinson DJ, Hossain T, Limb MC, et al. Impact of the calcium form of beta-hydroxy-beta-methylbutyrate upon human skeletal muscle protein metabolism. *Clin Nutr.* 2017.
21. Kuriyan R, Lokesh DP, Selvam S, et al. The relationship of endogenous plasma concentrations of beta-Hydroxy beta-Methyl Butyrate (HMB) to age and total appendicular lean mass in humans. *Exp Gerontol.* 2016;81:13-8.
22. Wu H, Xia Y, Jiang J, et al. Effect of beta-hydroxy-beta-methylbutyrate supplementation on muscle loss in older adults: a systematic review and meta-analysis. *Arch Gerontol Geriatr.* 2015;61(2):168-75.
23. Deutz NE, Pereira SL, Hays NP, et al. Effect of beta-hydroxy-beta-methylbutyrate (HMB) on lean body mass during 10 days of bed rest in older adults. *Clin Nutr.* 2013;32(5):704-12.
24. Coker RH, Wolfe RR. Bedrest and sarcopenia. *Curr Opin Clin Nutr Metab Care.* 2012;15(1):7-11.
25. English KL, Paddon-Jones D. Protecting muscle mass and function in older adults during bed rest. *Curr Opin Clin Nutr Metab Care.* 2010;13(1):34-9.
26. Beaudart C, Buckinx F, Rabenda V, et al. The effects of vitamin D on skeletal muscle strength, muscle mass, and muscle power: a systematic review and meta-analysis of randomized controlled trials. *J Clin Endocrinol Metab.* 2014;99(11):4336-45.
27. Rejnmark L. Effects of vitamin d on muscle function and performance: a review of evidence from randomized controlled trials. *Ther Adv Chronic Dis.* 2011;2(1):25-37.
28. Cangussu LM, Nahas-Neto J, Orsatti CL, et al. Effect of vitamin D supplementation alone on muscle function in postmenopausal women: a randomized, double-blind, placebo-controlled clinical trial. *Osteoporos Int.* 2015;26(10):2413-21.
29. Gama ZA, Gomez-Conesa A. Risk factors for falls in the elderly: systematic review. *Rev Saude Publica.* 2008;42(5):946-56.
30. Cuthbertson D, Smith K, Babraj J, et al. Anabolic signaling deficits underlie amino acid resistance of wasting, aging muscle. *FASEB J.* 2005;19(3):422-4.
31. Girgis CM, Clifton-Bligh RJ, Hamrick MW, et al. The roles of vitamin D in skeletal muscle: form, function, and metabolism. *Endocr Rev.* 2013;34(1):33-83.
32. Kinuta K, Tanaka H, Moriwake T, et al. Vitamin D is an important factor in estrogen biosynthesis of both female and male gonads. *Endocrinology.* 2000;141(4):1317-24.
33. Marzetti E, Calvani R, Cesari M, et al. Mitochondrial dysfunction and sarcopenia of aging: from signaling pathways to clinical trials. *Int J Biochem Cell Biol.* 2013;45(10):2288-301.
34. Ryan ZC, Craig TA, Folmes CD, et al. 1alpha,25-Dihydroxyvitamin D3 Regulates Mitochondrial Oxygen Consumption and Dynamics in Human Skeletal Muscle Cells. *J Biol Chem.* 2016;291(3):1514-28.
35. Dalle S, Rossmeislova L, Koppo K. The Role of Inflammation in Age-Related Sarcopenia. *Front Physiol.* 2017;8:1045.
36. Kwon YN, Yoon SS. Sarcopenia: Neurological Point of View. *J Bone Metab.* 2017;24(2):83-9.
37. Kougias DG, Das T, Perez AB, et al. A role for nutritional intervention in addressing the aging neuromuscular junction. *Nutr Res.* 2018;53:1-14.
38. Reinders I, Song X, Visser M, et al. Plasma phospholipid PUFAs are associated with greater muscle and knee extension strength but not with changes in muscle parameters in older adults. *J Nutr.* 2015;145(1):105-12.
39. Rodacki CL, Rodacki AL, Pereira G, et al. Fish-oil supplementation enhances the effects of strength training in elderly women. *Am J Clin Nutr.* 2012;95(2):428-36.
40. Smith GI, Julliand S, Reeds DN, et al. Fish oil-derived n-3 PUFA therapy increases muscle mass and function in healthy older adults. *Am J Clin Nutr.* 2015;102(1):115-22.
41. Kougias DG, Nolan SO, Koss WA, et al. Beta-hydroxy-beta-methylbutyrate ameliorates aging effects in the dendritic tree of pyramidal neurons in the medial prefrontal cortex of both male and female rats. *Neurobiol Aging.* 2016;40:78-85.
42. Salto R, Vilchez JD, Giron MD, et al. beta-Hydroxy-beta-Methylbutyrate (HMB) Promotes Neurite Outgrowth in Neuro2a Cells. *PLoS One.* 2015;10(8):e0135614.